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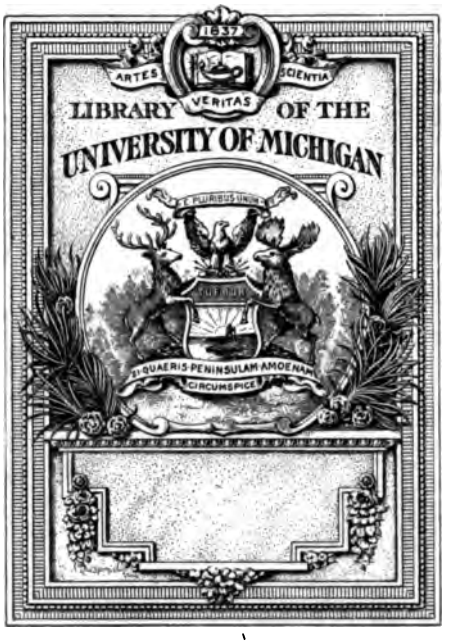

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60TH CONGRESS, 2d Session } HOUSE OF REPRESENTATIVES { DOCUMENT No. 1268

REPORT ON TRADE CONDITIONS IN MEXICO

By

ARTHUR B. BUTMAN

Special Agent of the Department of Commerce and Labor

TRANSMITTED TO CONGRESS IN COMPLIANCE WITH THE ACT OF MAY 22, 1908, AUTHORIZING INVESTIGATIONS OF TRADE CONDITIONS ABROAD

JANUARY 4, 1909

Referred to the Committee on Interstate and Foreign Commerce and ordered to be printed.

WASHINGTON
GOVERNMENT PRINTING OFFICE
1908

DEPARTMENT OF COMMERCE AND LABOR,
OFFICE OF THE SECRETARY,
Washington, December 18, 1908.

SIR: I have the honor to transmit herewith, in compliance with the act making appropriations for the legislative, executive, and judicial expenses of the Government for the fiscal year ended June 30, 1908, approved February 26, 1907, the report of Special Agent Arthur B. Butman on Trade Conditions in Mexico.

Respectfully, OSCAR S. STRAUS,
Secretary.

The SPEAKER OF THE HOUSE OF REPRESENTATIVES.

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LETTER OF SUBMITTAL.

WASHINGTON, *June 23, 1908.*

SIR: I have the honor to present herewith a report on industrial and commercial conditions in Mexico. My investigations in the Republic, made under your instructions, occupied several months, and while the larger portion of the time was spent in the capital city, the chief commercial center of the country, considerable time was passed in other important cities and towns; and agricultural, mining, and various sections were visited with the constant aim in view of coming into personal touch with both importers and consumers.

The Mexico which the traveler finds to-day, whether he crosses the Rio Grande or disembarks at Tampico or Veracruz, is practically a new country. "Old Mexico," while not forgetting the glories or achievements of the past, has already awakened to a sense of her vast powers for development and opportunities for industrial growth. The spirit of the Republic now is a spirit of progression, and the atmosphere one of advancement. It is a land rich in natural resources awaiting further material development, and one of splendid opportunity.

It is not to be denied that a large percentage of the population of Mexico, which in the year 1900 numbered 13,611,694, are of the peon class, who cling to traditional custom; nor that in isolated sections one sees the crooked stick for a plow, and the ox-cart with wooden disk wheels. Those, however, can not be taken as expressive of the ruling spirit in Mexico.

The Republic is rapidly advancing agriculturally, industrially, and commercially, which means added requirements to be supplied from foreign sources. Commercial intercourse between Mexico and the United States has grown steadily, and Mexico is finding a larger and better market for her raw materials in our country, while more American goods are handled in Mexico than ever before. Notwithstanding that fact Europe is constantly gaining ground. There are many details of Mexican trade and its requirements which our people fail to understand, or, understanding, fail to meet; these, together with a résumé of present industrial conditions in the country, I have endeavored to set forth in the following pages.

Respectfully,

ARTHUR B. BUTMAN,
Special Agent, Department of Commerce and Labor.

To Hon. OSCAR S. STRAUS,
Secretary of Commerce and Labor.

TRADE CONDITIONS IN MEXICO.

FOREIGN CAPITAL INVESTED.

The growth and influence of the Mexican Republic is daily becoming of more importance to the world at large. Its leaders in thought and affairs, realizing the necessity for outside aid in developing the natural resources of the country, have wisely framed such laws as are a safeguard to the commercial, financial, and industrial interests, and the constant increase in the foreign capital invested in Mexico is the reflex of their action. The reputation for solidity, following upon prudent management, held by the banking institutions of Mexico is widely extended, and I am confident that the same is well deserved.

The minister of finance furnishes the following interesting information concerning the amount of capital invested by citizens of the United States, France, England, and Germany in Mexico during the fiscal year 1906, the first year after the monetary reform in the Republic: Total amount, not including the amount invested in the form of machinery and merchandise, or in bonds of the Federal or State Governments, $43,077,000, divided as follows: Banks, $28,684,800; mortgages, $996,000; industry, $4,930,200; mines, $3,735,000; other property, $1,743,000; and railroads, $2,988,000.

MINING.

In the production of silver Mexico leads the world, and in copper she holds the second place, being surpassed only by the United States; in both gold and lead she stands fourth, while her zinc deposits, the possibilities of which are as yet unrealized, are being mined on a larger scale than ever before. It is impossible to secure statistics showing the accurate yield of Mexican mines. It is stated, however, that the production of the precious metals, with copper and lead, forms approximately 95 per cent of the whole mine product. The following statement regarding the Mexican output of gold and silver is furnished by the minister of finance:

Bearing in mind the fact that the consumption of metals within the Republic is comparatively insignificant, and that as fast as ore is taken from the mines it is either treated or exported, for in general our mining companies do not allow their ore to accumulate, it is possible to arrive at a very approximate knowledge of the output.

The exportation of gold from Mexico for the fiscal year 1907 was as follows:

In Mexican coin	$14,924
In foreign coin	5,015
Gold bullion	9,415,012
Gold ore and gold in other forms	2,454,148
Total	11,889,099

The total exportation of gold, minus the amount sent abroad in coins, was $11,869,159, to which, if the $6,339,661 worth delivered during the period for coinage purposes to the Exchange and Currency Commission be added, makes a total production of gold for the year of $18,208,821, an increase in production of $81,621 over the fiscal year 1906.

The production of silver, calculated in the same manner, amounted to $38,390,235 during 1907, an increase of $738,644 over the previous year.

Official statistics of the production of all other minerals depend likewise upon the recorded export values, which for the fiscal year 1907 totaled $18,182,229. The development of the mining industry is on the increase in Mexico, as shown by the number of deeds recorded during the first half of the present (1908) fiscal year, which numbered 3,000 title deeds embracing 60,852 claims. This registration is the largest ever made during a like period of time.

AGRICULTURE.

Agriculture, owing to improved transportation facilities, has within a few years greatly advanced. The diversity of climate and soil render the cultivation of tropical, semi-tropical, and temperate zone crops possible, while concerning the yield of some of these crops marvelous statements are made.

The cultivation of sugar cane seems to have proven an especially profitable enterprise for American planters engaged therein in Mexico. The cost of virgin lands suitable to the growth of sugar cane, as well as the cost of labor, is comparatively low, while the cane yield is abundant, especially on plantations situated within the Tropics. In my preliminary report on the Mexican sugar industry, published in the Daily Consular and Trade Reports of February 21, 1908, also supplementary report published April 8, facts and statistics in regard to both the production of sugar and trade in the commodity were given in detail. It need only be further stated here that the industry is becoming more and more an important one, and that it is receiving added protection from the Mexican Government by an increased rate of import duty placed on foreign sugars. Modern methods of manufacture have improved the quality of the product, while the home consumption is constantly increasing.

Mexican coffee finds a good market in Europe and is also exported to the United States. The condition of the coffee industry shows a

healthy tendency, inasmuch as the larger planters at least have introduced modern methods of curing the bean. Improved grades of coffee and more lucrative sales are the results already shown. The States producing the larger quantity of coffee at present are Oaxaca, Veracruz, Tabasco, and Chiapas. In export returns for the last fiscal year coffee shows a falling off in both quantity and value, which is accounted for by a poor crop, since the areas under cultivation are increasing rather than diminishing. The production of henequen or sisal fiber was set forth in detail in a report printed in the Daily Consular and Trade Reports of December 5, 1907. The State of Yucatan is the home of this particular fiber, and it is estimated that 100,000 acres are under this cultivation on the Yucatan peninsula. The average size of the individual plantation is 500 acres. Of agricultural exports from Mexico henequen yields by far the most valuable returns. The cultivation of ixtle, another indigenous fiber plant, for commercial purposes is also increasing.

COTTON AND RUBBER.

As regards the production of cotton, while it is claimed that there are lands outside the Laguna district, the section where probably 85 per cent of the fiber now produced is grown, well suited to cotton cultivation, it is nevertheless true that the acreage under cultivation does not increase despite the fact that active efforts have been made to effect such an increase. Mexico does not produce sufficient cotton for the consumption of her cotton mills, probably not more than one-half the amount required, the United States supplying the bulk of the remainder. Cotton-seed products are rapidly becoming an important commercial proposition here and exports of cotton-seed meal and cakes have considerably more than doubled during the past five years.

The production of rubber is receiving marked attention at the present time, and the success of this cultivation in Mexico would seem to be no longer a matter for question. I am informed that one company alone has 20,000 acres in trees ranging from a few months to seven years of age.

The minister of finance in reviewing the exports of Mexico for the last fiscal year states, regarding the rubber situation: "Foremost among the products of which the exportation increased are rubber, including guayule rubber, the exportation of which began five years ago and now exceeds $6,500,000 Mexican ($3,250,000 United States currency) per year."

TIMBER RESOURCES.

The area of first-class timber in Mexico is estimated as comprising from 20,000,000 to 25,000,000 acres. The heaviest stumpage of pine and oak are found in the States of Chihuahua, Durango, Jalisco, Michoacan, and Guerrero. The largest bodies of tropical hard woods,

or cabinet woods, are located in the Gulf States. The best timber is still more or less remote from transportation, but the railroads are beginning to open up the country in some of the lumber districts, and the industry, while now in its infancy, bids fair to experience a wide development with the advent of increased transportation facilities.

Detailed information concerning the extent of Mexican timber lands, varieties of hard woods, ratings of the same, estimated cost of the logging and manufacturing in Mexico, etc., may be found in the report on the subject printed in the Daily Consular and Trade Reports of January 31, 1908.

MANUFACTURING.

The manufacturing industries are of inconsiderable importance as compared to the mineral and agricultural resources of the Republic. The lack of native fuel, as well as lack of capital and expert knowledge, is largely responsible for the small extent of manufacturing which exists. The adoption in recent years of electricity as a motive power, together with the introduction of foreign capital and experience, and the protection afforded native industries by the Government in levying customs duties, will doubtless in time bring about a development in manufacturing hitherto unknown to the country. It is probable that owing to the lack of coal supply few countries have proportionately resorted more largely to the utilization of water power for the generation of electricity than Mexico.

The general character of the country is mountainous, so that while there are no large rivers the high waterfalls make possible such development. Generally speaking, however, the value of a water power in Mexico depends largely upon the construction of storage reservoirs for retaining the flood waters, since the wet and dry seasons prevailing throughout the country render variable the flow of the streams, and only by this method may a trustworthy power of large proportion be obtained.

Within a comparatively recent time the use of electricity has been introduced into various mining camps and large amounts of electrical machinery placed in mining work. The most notable development of electrical force from hydraulic power is that of some Canadian capitalists, officially known as the Mexican Light and Power Company, one of the largest electric power plants of the kind in the world.

LEADING MANUFACTURES.

The manufacture of cotton textiles for home consumption is the most successfully established native industry. The latest official statistics available give the number of Mexican cotton mills as 128, employing 30,162 persons, operating 678,058 spindles and 22,021 looms. The larger number of factories are located in the central States, Puebla heading the list with 29 mills. The mills of Orizaba,

State of Veracruz, are known to the cotton manufacturing world at large. They are modern plants, well equipped and complete in detail. The principal output of Mexico's cotton factories is of the cheaper grades of prints and sheetings, though in a few cases certain fine-class fabrics are produced.

The growing of cotton in the Republic and the various branches of the cotton textile industry were described in a preliminary report published in the Daily Consular and Trade Reports of February 29, 1908.

Breweries, soap manufactories, and iron and steel industries are manufacturing plants of importance in the country. The latest available statistics give the number of breweries as 37, the number of soap manufacturing plants as 305, and the number of iron mills and foundries as 21. The principal iron and steel plant is located at Monterey, in the northern State of Nuevo Leon, concerning the output of which a brief description has been previously furnished. The combined output of none of these industries is sufficient to meet the domestic demand.

TRADE WITH THE UNITED STATES.

A large percentage of Mexico's foreign commerce is carried on with the United States, both in imports and exports. It is impossible to state just the amount of American capital invested in Mexico, but from $750,000,000 to $800,000,000 is a conservative estimate, concerning the bearing of which upon our trade with that country no comment is required.

Another important fact in connection with our trade relations is the residence in Mexico of large numbers of our own countrymen, it being a proved precedent that where the citizens go in any considerable number the country's goods follow. A striking example of the above is the present large volume of Italian trade with certain South American countries, following upon the colonization movement.

FOREIGN COMMERCE.

The values of the total exports of Mexico as shown by official statistics were for the past three fiscal years as follows: 1905, $103,843,184; 1906, $135,027,026; 1907, $123,512,968. These totals were represented in detail by the following articles:

Articles.	1905.	1906.	1907.
Gold	$14,124,216	$15,784,496	$11,889,109
Silver	22,630,775	62,449,241	49,731,171
Other mineral products	18,136,388	17,735,435	18,182,229
Vegetable products	29,419,981	31,338,211	35,761,566
Animal products	5,231,549	5,838,265	5,553,660
Manufacturing products	3,919,239	1,483,263	1,875,713
Sundry	381,933	398,112	519,520

Included in "Other mineral products" are copper and lead, with the following quantities and values for 1907: Copper, including copper ore, 156,644 metric tons, valued at $14,338,803; lead, including lead ore, 69,077 metric tons, valued at $1,815,080. During the past five years the exports of copper have increased, owing to the advance in the price of the metal, some $4,000,000. Lead, on the other hand, shows a falling off in both quantity and value.

VEGETABLE PRODUCTS.

After minerals, in export valuation, follow vegetable products, which show a constant and satisfactory increase.

Since the purchasing power of a nation is largely determined by her resources as measured by the valuation of her exports, the following detailed tables of the principal vegetable products exported may prove interesting:

Articles.	1905.	1906.	1907.
Henequen fiber	$14,635,785	$14,659,784	$15,657,242
Istle fiber	1,740,843	1,826,586	1,898,961
Coffee	4,609,877	4,625,934	3,604,289
Leaf tobacco	1,357,230	1,103,708	943,625
Chick-peas	1,122,246	1,474,489	2,034,091
Chicle	808,486	844,868	1,068,072
Woods	1,094,511	937,217	1,080,549
Dye woods	344,524	266,772	368,425
Rubber, including guayule	358,113	1,190,431	3,326,105
Guayule plants	.....	58,278	30,490

ANIMAL PRODUCTS, SUGAR, COTTON SEED, ETC.

Cattle and untanned hides form the chief exports of animal products, concerning which the following returns are given for the three years' period:

Articles.	1905.	1906.	1907.
Cattle	$1,166,932	$1,256,946	$598,443
Untanned hides	3,356,326	3,925,667	4,419,795

It is stated that the falling off in cattle exports for 1907 was due to the increased home demand.

Exports of the chief articles of manufactured and sundry products with their respective valuations were as follows:

Articles.	1905.	1906.	1907.
Refined sugar	$2,847,288	$335,709	$579,340
Coarse sugar	26,449	8,281	13,282
Cotton-seed meal and cakes	280,278	281,718	421,447
Palmetto hats	160,988	277,260	314,347
Tanned hides and skins	143,376	107,487	17,371
Manufactured tobacco	231,792	185,918	248,627

The principal exports to the United States are copper, lead, goatskins and hides, coffee, and textile grasses. The United States is Mexico's best customer, furnishing by far the largest market for her export trade. Statistics of exports for the year 1907 to the following countries are as follows: United States, $87,852,943; Great Britain, $15,873,263, and Germany, $10,014,612. France, Belgium, Spain, and the West Indies follow in the order mentioned, each taking smaller quantities than the other countries named.

IMPORTS—STATUS OF DIFFERENT COUNTRIES.

More than two-thirds of Mexico's exports are sent to the United States, and nearly two-thirds of her imports come from that source. The imports from Germany in value are only about one-sixth of those from the United States, while from Great Britain and France they are considerably less than one-sixth. The imports from other countries are insignificant in comparison.

Germany sells more goods to Mexico than does Great Britain, and she buys less from the Republic. German exports are more than $2,000,000 in excess of her imports from Mexico, while the imports of Great Britain are nearly $4,000,000 in excess of her exports; France sells more than double the value of the goods she buys. The following statistics for 1907 show the various countries from which Mexican imports are drawn, with the increase in value over 1906:

Country.	1907.	Gain over 1906.	Country.	1907.	Gain over 1906.
United States	$72,895,539	$415,806	France	$8,781,624	$728,307
Germany	12,165,767	1,872,739	Spain	3,970,542	189,234
Great Britain	11,749,275	1,698,867			

The statistics given are those of the Mexican Government. The exports to Mexico in 1907, as shown by the official returns of the United States, aggregated in value $67,692,618, while the imports from that country were of the value of $57,000,795. The nations of Europe show keen interest in Mexico's markets, and Canada is conducting an active commercial campaign there.

As showing that Mexico herself is alert to the improvement of her foreign trade it may be stated that during the past year the department of foreign affairs issued an order classifying her consular service in order that more time may be devoted to the collection and dissemination of information to promote commerce, industry, and agriculture. This departure was made not only to furnish better statistics of existing trade relations, but to encourage new business, a special feature being the study of the needs of the territory within the jurisdiction of the consular official and the collection of information relative to articles produced therein, which information might be of value to Mexico.

WHAT MEXICO IMPORTS.

Mexican imports are classified, according to the tariff, into eleven groups. These are given in the following table, in which the valuations are in round numbers, and comparison is made with the returns for the fiscal year 1906:

Articles.	1906.	1907.	Articles.	1906.	1907.
Animal substances	$7,941,734	$9,360,314	Paper, and applications thereof	$2,646,364	$2,933,064
Vegetable substances	15,852,264	15,441,769	Machinery and apparatus	9,932,871	13,497,598
Mineral substances	44,160,203	40,329,547	Vehicles	2,236,230	4,379,996
Textiles, and manufactures thereof	11,024,720	12,895,588	Arms and explosives	2,006,390	1,901,789
Chemical and pharmaceutical products	3,759,166	4,626,557	Sundry	3,969,054	4,649,337
Spirituous, fermented, and natural beverages	3,535,425	3,550,711	Total	107,064,421	113,566,270

The most important increase during the year was that of machinery and apparatus of all kinds.

The principal articles imported from the United States are coal, lumber, explosives, manufactures of iron and steel, raw cotton, wheat, and boots and shoes. Mexican importations of wheat and corn fluctuate according as the home crops are good or bad. Under normal conditions the Republic does not fully supply her own breadstuffs, her average annual wheat importations from the United States averaging about $800,000 or $900,000, though $2,000,000 worth was imported in 1906.

LUMBER AND FURNITURE.

Approximately 70 per cent of the lumber used in Mexico at the present time is imported, owing to the undeveloped state of the country's timber resources. Importations of furniture show a steady growth, and the market here is one of good promise to American manufacturers. This is especially true of office furniture. In upholstered goods competition with European makers is very keen. It is the goods of high grade that have the larger demand in Mexico.

In shipping furniture to this country great care should be taken to give the following details in full on the invoice accompanying the goods, as required by the customs law: The kind of wood, whether solid, common, stained in imitation of hard woods, or veneered, of which the article is made; and if upholstered, the kind of cloth, whether cotton, wool, silk, or a mixture of these textiles which enters into the upholstery.

MANUFACTURES OF IRON AND STEEL.

The large increase shown in the importation of iron and steel manufactures in 1907 shows the rapid development of Mexico's industries. In a preliminary report the machinery situation, with reference to mining and sugar-making machinery, was presented at some length,

and anything further than a brief résumé of conditions at present obtaining in the market must needs be a repetition of that report. The value of United States machinery exports to Mexico for the past two fiscal years is shown in the following table:

Description.	1906.	1907.	Description.	1906.	1907.
Electrical machinery	$974,248	$1,241,546	Steam engines, and parts of:		
Metal-working machinery	69,129	80,693	Locomotives	$466,536	$1,235,836
Mining machinery	(a)	3,280,987	All other	663,525	630,809
Pumps and pumping machinery	1,054,965	1,144,069	Typewriting machines, and parts of	348,072	372,858
Sewing machines, and parts of	696,543	779,647	All other	4,090,014	2,521,970

a Included in "All other machinery" prior to July 1, 1906.

Our most formidable competitor is Great Britain, particularly as regards sugar-making machinery. The United States holds the market for mining machinery, though Great Britain, Germany, and France each supply a small percentage. The market for electrical machinery and apparatus is already large, and bids fair to continue to increase.

AGRICULTURAL MACHINERY AND IMPLEMENTS.

The agricultural industry affords opportunities of promise for the introduction of agricultural machinery, implements, and tools. Patience and perseverance are necessary, as the training of the consumer has been along lines quite different to those prevailing in the United States. Well-stocked agencies for American agricultural implements are established in the principal towns of the Republic, and while present sales are considerable there is room for great improvement. Competition is offered by German and English agricultural implements, but with the exception of thrashers, where preference is in instances given the British-made machines, and double-molded board and gang plows, which the Germans have introduced in agricultural sections, our competitors have not as yet made much headway.

American implements are lighter in construction, less complicated, and better suited to the needs of this country than those of European origin, and the majority of haciendados give preference to our products for these reasons.

HARDWARE—VEHICLES, AUTOMOBILES, ETC.

Importation of builders' hardware of American manufacture show considerable gains, and the products are deservedly popular; but there is sharp competition offered in these lines by Germany, which is the most marked and keen in the northern portions of the Republic, where the trade appears to be controlled by German houses.

The second largest increase in Mexico's imports for 1907 was in vehicles. Included under this head are freight cars, of which large

importations were made, and there was also a large increase in automobiles. The automobile trade with the United States has rapidly advanced, showing the third largest foreign market for American cars. During the five-year period 1903–1907 the exports of automobiles to Mexico from the United States advanced from $24,762 to $812,639, while valuations for the past three fiscal years, 1905–1907, were respectively $119,986, $422,626, and $812,639. The gradual further improvement of Mexican highways, already traceable in many instances more or less directly to the demands of the automobilist, is certain to prove an important factor in enlarged future sales of such cars. French, Italian, German, and English automobiles are sold here, but the present outlook for American machines seems to be of the best.

OUTLOOK FOR FOOD PRODUCTS.

The recent establishment of the Mexican National Packing Company's plant at Urupan effected a new departure in this country, and is a notable example of the commercial and industrial advance now taking place within its boundaries. The enterprise was honored with a special paragraph in the message of President Diaz to the Mexican Congress on April 1 last, and great expectations as to its future good results for the country are anticipated. In the opinion of an old representative in Mexico of one of the largest Chicago packing houses, the interests of the United States packers will not be greatly affected by the establishment of this new plant. The United States sends practically no refrigerated meats to Mexico at present, and the trade in hams and bacon and canned meats, from the immediate outlook at least, is not likely to decrease. Mexican prices of all meats and foodstuffs may be considered as ranging high.

PRICES OF FOOD PRODUCTS.

The following list is illustrative of the general prices of certain food products in Mexico. The prices are retail per kilo (2.2 pounds) unless otherwise stated, and are given in United States currency:

Articles.	Price.	Articles.	Price.
Hams and bacon	$0.57	Wheat flour, American ....per pound	$0.09
Beef:		Rice, American	.20
Rib roast	.45	Beans, American	.20
Porterhouse	.45	Dried fruit	.50
Tenderloin	.50	Cocoa, American ....per pound	.90
Pork	.45	Cocoa, Dutch ....do	1.25
Lamb and mutton	.45	Tea ....do	$0.62–1.50
Veal	.50	Coffee ....do	.20
Sausages	.45	Condensed milk ....per can	.20
Canned fish ....per pound	.20	Canned apples, American, per 3-pound can	.62
Salted cod ....do	.15	Breakfast foods, American, per package	.22
Butter, American ....do	$0.50–.62½	Biscuits:	
Oleomargarine, American ....do	.30	Uneeda ....per package	.15
Lard, American ....do	.18	Fancy, American ....per pound	.42
Cheese:			
American and Canadian	.65		
European	.75		

In dried and canned fruits, bottled pickles, etc., the United States does a considerable trade here; but England is a strong competitor, and it is said that the first cost of the English products is often less than that of the American; also complaints are made regarding American packing. In certain kinds of canned goods French products have a preference, owing, more than any other reason, it seems, to the very neat and artistic manner in which the goods are sent out.

In the fancy biscuit line England is also strongly asserting herself, but the United States holds a good proportion of the trade.

WINES AND LIQUORS.

Wines scarcely afford a promising field for the American export trade, nor is it probable that the situation will greatly change. American clarets must meet in competition low-priced wines of Spanish and French origin which have long held the Mexican market, thereby offering small chance for the sale of American brands. Champagnes and brandies are likewise furnished largely by French houses. American whiskies are widely advertised and are gradually gaining in sales throughout the country.

TEXTILES, DRY GOODS, ETC.

Native mills supply a large amount of the cotton textiles needed for the home market, and Great Britain furnishes the principal foreign supply. France holds the fine dry goods and millinery trade, and the highest grades of women's and infants' ready-made wear are of French origin. In all lines of men's furnishing goods and ready-made wearing apparel American articles are deservedly popular.

Woolen textiles are furnished principally by England and France. There is no prejudice existing in Mexico against either woolen or cotton piece goods of American manufacture, the source of supply being largely governed by the matter of price.

CHEMICALS, DRUGS, AND MEDICINES.

The United States should furnish a larger share of Mexico's requirements along these lines than is now the case. There is a growing demand for patent and proprietary medicines, and the field for such is a valuable one. The important drug and chemical houses throughout the country, both wholesale and retail, are principally German and French, and in many such things German goods control the market. A good proportion of proprietary medicines are furnished by the United States. France continues largely to hold the trade in perfume and toilet articles, this being due in part to the wide advertising which has been given to this nation's goods. The market for essential oils is an important one, also for flavoring and coloring

extracts, but the strong competition from English, French, and German sources must not be underestimated.

Proprietary or patent medicines manufactured in the United States are subject to a high Mexican tariff; accordingly some half-dozen prominent American houses have successfully established local bottling branches in Mexico, thereby enabling them to put out their medicines at lower prices than would otherwise be possible. Two very essential factors for this trade in all lines are personal representation and extensive advertising.

SEWING MACHINES AND SANITARY AND ELECTRICAL FITTINGS.

American products in phonographs, sewing machines, and typewriters control the field.

All the larger cities in Mexico are taking up the problem of modern improved sanitation, and the general enforcement of sanitary laws following upon this action is creating a wide demand for sanitary appliances and equipment of every kind.

The installation of electric power plants in many sections opens up opportunities in these localities for the introduction of electrical fittings, and all appliances connected therewith. American manufacturers of these goods will do well to have a constant eye to Mexican needs and to remember that competition with Germany must be met.

SHOE AND LEATHER TRADE.

Leather tanning is carried on to a considerable extent throughout the Mexican Republic. Mexico City and Leon are centers of the tanning and leather trade, but there is scarcely a city or town in the entire country which does not boast one or more tanneries. The quality of Mexican tanned leather is, however, as a whole inferior, and as a foreign commercial proposition has not proved a success.

The boot and shoe industry in Mexico is as yet in its infancy, there being not more than ten or twelve modernly equipped factories in the Republic, turning out on an average from 50 to 450 pairs per day, with the exception of the two largest which maintain a capacity of 2,000 and 1,000 pairs, respectively, daily. The small "to order" and "by hand" shops are numerous in all localities.

The modern equipped establishments are furnished with American machinery, and the more important firms are composed of Americans, employing American foremen, using lasts and upper leathers imported from the United States, and turning out a well-made Goodyear and McKay shoe. This class of goods enters into keen competition with shoes from the United States, but the average lower grade Mexican-made shoe, owing to the lack of skilled workmen, is inferior to a corresponding grade of shoe made in the United States. For the benefit of those intimately interested in the boot and shoe export

trade with Mexico the following cost of production in that country, showing the average weekly wages of operatives in shoe factories, is furnished, ten hours constituting a day's labor:

Description.	Weekly wages.	Description.	Weekly wages.
Rough stuff cutting	$3.75	Channel laying	$4.00
Channeling Goodyear soles	3.75	Channel closing and leveling soles	3.75
Cutting or clicking	6.00	Nailing heel seats	3.75
Upper fitting and stitching ..... each	.11	Stitch separating by machine	3.75
Counter skiving	2.50	Heel attaching	6.00
Box toes skiving	2.50	Top-piece slugging by machine	4.50
Pulling over by hand ..... each	.035	Heel trimming	4.50
Lasting on Consolidated	6.00	Heel breasting	4.50
Welt sewing on Goodyear machine	7.50	Edge trimming	7.50
Inseam trimming	4.50	Heel scouting	5.00
Welt hammering	3.75	Inking and edge setting	6.00
Trimming and fixing shank pieces	4.50	Inking and finishing heels and seat wheeling; sole buffing; shank buffing by Naumkeag; sole and shank finishing, including laying colors; cleaning up, and taking out last	$3.00-6.00
Sole laying, Goodyear	4.50		
Rounding and channeling on last	7.50		
Channel opening on last	2.50		
Sole stitching, Goodyear Rapid	6.00		

MARKET FOR AMERICAN-MADE SHOES.

The United States has already achieved a large measure of success in the boot and shoe trade with Mexico. The exports of these products of American manufacture for the five-year period 1903–1907, inclusive, which follow, attest the popularity which the American shoe has gained in the Mexican Republic:

Year.	Pairs.	Value.	Year.	Pairs.	Value.
1903	402,804	$623,804	1906	843,398	$1,529,364
1904	496,183	786,502	1907	810,859	1,569,321
1905	683,840	1,116,598			

Men's footwear for this trade is made principally on a characteristic American-shaped last, and the same leathers are employed as are used in the United States. Both the balmoral and Oxford styles are worn, and altogether there is but small difference between the demands of the Mexican and those of the American trade. There is a certain demand for a shoe for men's wear made on the long, narrow Spanish-shaped last. This special style has been conformed to by at least one American manufacturer, who in thus wisely catering to a marked taste of the foreign buyer has reaped satisfactory results. Another preference of the trade is for a sole of lighter weight than that usually required for the United States home trade, which applies to both women's and men's footwear. The styles most desirable in women's goods are fashioned along French rather than typically American lines, with Cuban and Louis XV heels. For afternoon or dress wear fancy goods have a decided popularity, which has been well met by American manufacturers in outputs of special lines. There is perhaps a slight preference for the high shoe, button or laced, over the Oxford.

American shoes usually retail in Mexico City for from $5 to $6 a pair, both men's and women's. An extra high shoe for miners' wear sells for $6.75; men's white canvas balmorals for $4.25; Oxfords of the same material, $3.75; men's dancing pumps for $5.75; slippers, "Opera" for $3.25, and "Romeo" for $4.25. Women's white canvas Oxfords and slippers are sold at $3.75. Special lines of women's fancy shoes at $7.50.

Americans meet a considerable amount of competition in hand-made Spanish shoes, which are sold often at a price lower than is asked for the American shoe. I heard a good deal about this competition in the northern cities, where, owing perhaps to the proximity of the region to the United States, the use of modern wearing apparel and footwear is being more generally adopted by the lower classes. Nor is the wearing of proper footwear by these classes by any means confined to the north, as it is, to a certain degree, general all over the Republic. Americans living in Mexico say that the change in this respect during the past five years has been a wonderful one.

It would seem that a good opening for the introduction of a cheaper grade of American shoe than is now on the market is thus afforded. The future demands for such a line of shoes would seem, judging from the present trend of conditions, to be well worth the personal investigation of those interested.

MEXICAN RAILWAYS.

There are at the present time approximately 14,000 miles of railways in Mexico. The Tehuantepec National Railroad, opened in January, 1907, which crosses the Isthmus of Tehuantepec, is carrying on a large volume of business. The land haul from terminal to terminal is 190 miles, and the time occupied is less than twenty-four hours. During the year 1907 the value of American commerce passing over this Mexican transcontinental railroad is estimated as having been between $25,000,000 and $30,000,000.

The Tuxpam-Manzanillo extension branch of the Mexican Central Railroad approaching completion will open up a new transcontinental route, the benefits of which will be incalculable to the Republic. The development of the Pacific coast States of Mexico will derive new impetus, and rich agricultural districts will be given communication with the outer world through this needed outlet. Channels of trade between these localities and Pacific ports of the United States, British Columbia, Central and South America, and the Far East will thus be opened and more economical importation of foreign products made possible. This extension is 100 miles in length, and the opening to traffic is expected to take place next September.

The Kansas City, Mexico and Orient Railway will, when completed, furnish Mexico's third transcontinental route. This line,

which is now under construction between Kansas City, Missouri, and Topolobampo, Sinaloa, on the Gulf of California, has its entire distance of 1,659 miles surveyed and located and right of way secured. The line is at present about one-half completed. It receives a subsidy from the Mexican Government amounting to about $2,750,000, which is paid in Government bonds as construction progresses. In addition, subsidies are also granted the road by the States of Chihuahua and Sinaloa.

The local development which is sure to follow upon the advent of this line, both in western United States and Mexico, can not be too highly estimated. It crosses the most productive area of Oklahoma, opening up a region much in need of railway facilities. Between the Red River and San Angelo, in Texas, a distance of 200 miles, it is developing a region that is rapidly being transformed from a grazing to a farming country. In the mountains east of Chihuahua is being opened up an important mineral region in silver, lead, and zinc, and the field for oil development is also attracting attention there. West of Chihuahua in the Sierra Madres access will be furnished to one of the best timber belts in Mexico. The Hamburg-American Steamship Company has entered into a contract with this railway company to put on a line of steamers from Topolobampo to Hawaii, the Philippines, Japan, and China as soon as the railway is completed.

Another important railroad undertaking in the Republic is the extension of the Southern Pacific West Coast Trunk Line, which is being built from the terminus of Guaymas to the city of Guadalajara, under the name of Cananea, Rio Yaqui and Pacific Railroad.

The mileage of the various railways, not including side tracks, of the Republic and the source of the capital invested in them are shown in the following table:

Name of road.	Capital invested.	Miles.
Mexican Central	United States, British, and German	3,402
National	United States, British, and Mexican	1,732
Interoceanic	British and Mexican	736
Hildago y Nordeste	Mexican	154
Mexican	British	321
Mexican Mineral	United States	15
Mexican Northern	do	81
Mexican Southern	British	213
Tehuantepec National	Mexican and British	210
Durango Central	United States	22
Mapimi	Mexican	15
Vera Cruz and Pacific	United States and Mexican	265
Vera Cruz	British	45
Coahuila and Zacatecas	do	95
Linares and Gulf	United States	40
Chihuahua and Pacific	do	162
Chihuahua Mineral	Mexican	16
Jalapa and Cordoba	United States	19
Sonora	do	265
San Rafael and Atlixco	Spanish	70
San Gregorio	Mexican and United States	19
Central de Potosi	United States	10
Rio Grande, Sierra Madre and Pacific	do	100
Kansas City, Mexico and Orient	do	182
Zituacuare	British	16
Pan American	United States	242
Oaxaca Ejutla	British	48

Name of road.	Capital invested.	Miles.
Nacozari	United States	77
Cazadero-Solis	Mexican	23
United Railways of Yucatan		405
Merida a Peto	Mexican	133
El Oro	British	30
San Luis Potosi to Rio Verde	United States	38
Cordoba a Huatusco	Mexican	20
Torres a Prietas	United States	13
Ixtlahuaca	British and United States	23
F. C. del Desague	Mexican	27
F. C. de Tlaxco	do	15
Cananea, Yaqui and Pacific	United States	39
Total		10,382

COMPETITORS GAINING ON THE UNITED STATES.

There are many lines of trade other than the ones already noted, in which the demands of Mexico's markets are considerable. While the trade returns afford just cause for a certain degree of satisfaction, it must not be forgotten that competitors of the United States while holding in comparison but a small percentage of Mexico's trade are at the same time making more rapid progress. The reasons for this fact are attributed to various causes, but in the main this may be laid at the door of those old and hackneyed misdemeanors of improper packing, slow delivery, and failure to make good promises regarding the goods, inattention to necessary details in invoicing, unwillingness to cater to special requirements or to meet terms of credit offered by competing nations, and lack of personal representation, with ignorance of actual conditions. There has been improvement, but there is room and great necessity for a much wider improvement.

The banking and financial laws of Mexico are founded on a solid basis. Failures in business are exceptional. While the Mexican may consume a long time in debating about the price of his purchases, when the transaction is completed he will adhere strictly to his word. European competitors show every consideration to the Mexican buyer as regards credits. Both Dun's and Bradstreet's commercial agencies have branches in the important cities of the Republic, through which full reports on prospective purchasers may be obtained.

The American exporter should pay every attention to the shipping instructions received from the Mexican buyer. For instance, instructions that certain articles be knocked down, and the different parts securely boxed in certain sized packages, and no package to weigh over a certain amount, may seem tedious to follow, but if final transportation of the shipment must be made on mule or burro back, a piece of machinery weighing two or three tons can not well be taken apart at a small interior railroad station. The routing of shipments is important. Goods which must be transshipped at Tampico or Veracruz should be strongly boxed, and furnished, in the case of drygoods, etc., with inside protection against sea or tropical dampness.

Advertising matter printed in English, employing the English system of weights and measures, and stating prices in American currency is of small value. Catalogues and literature for circulation in Mexico should be printed in Spanish; should state the cost of each article in Mexican money (pesos and centavos), and should, in addition, furnish such information as will enable the prospective buyer to arrive at the cost of the commodities offered in Mexican money laid down in Mexico.

The salesman who undertakes to sell American goods in Mexico, should not only speak Spanish, but should know something of the people, their customs, peculiarities, and their social as well as business ideas; he should also understand the laws of the country.

Two facts which should be considered perhaps first of all, at least must be ever borne in mind, are that the seller is an Anglo-Saxon, the buyer a Latin, and that as far as customs, language, ideas, ways of living, business methods, etc., are concerned, the two races are nearly opposite. The proverbial "old Spanish courtesy" obtains in business as well as social relations, and the short, curt business letter sometimes sent out by American houses does not always fit the Latin-American idea, however much it may be preferred between American business men, or however good the results obtained from such correspondence in the United States.

It is by no means intended to infer that the American business man encounters any insurmountable obstacles in dealing with the native Mexican trade; on the contrary, if the American will conform to certain rules and customs he will find no more difficulty in Mexico than in his own country. The fundamental principles of selling goods in Mexico are not different from those in the United States, but a difference lies in the details of those principles which, by careful study, may be so arranged as to successfully fulfill all required conditions to the satisfaction of the purchaser and the betterment and enlargement of American trade interests.

Mexico assuredly offers a splendid opportunity for increased American export trade relations.

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2d Session } { No. 1269

REPORT ON TRADE CONDITIONS

ON THE

WEST COAST OF SOUTH AMERICA

By

CHARLES M. PEPPER

Special Agent of the Department of Commerce and Labor

TRANSMITTED TO CONGRESS IN COMPLIANCE WITH THE ACT OF MAY 22, 1908, AUTHORIZING INVESTIGATIONS OF TRADE CONDITIONS ABROAD

JANUARY 4, 1909

Referred to the Committee on Interstate and Foreign Commerce and ordered to be printed.

WASHINGTON

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1908

DEPARTMENT OF COMMERCE AND LABOR,
OFFICE OF THE SECRETARY,
Washington, December 18, 1908.

SIR: I have the honor to transmit herewith, in compliance with the act making appropriations for the legislative, executive, and judicial expenses of the Government for the fiscal year ended June 30, 1908, approved February 26, 1907, the report of Special Agent Charles M. Pepper on Trade Conditions on the West Coast of South America.

Respectfully,

OSCAR S. STRAUS,
Secretary.

The SPEAKER OF THE HOUSE OF REPRESENTATIVES.

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LETTER OF SUBMITTAL.

WASHINGTON, *June 25, 1908.*

SIR: The appended report reviews the Pan-American commerce of the area included in the west coast of South America from Panama to the Straits of Magellan. This area has a population of nearly 12,000,000 inhabitants and an international trade of $250,000,000 and upward annually. The proportion of the United States in this trade is approximately $50,000,000, with the balance usually in favor of the countries of the Southern Continent. Since the construction of the Panama Canal was begun by the United States it has been apparent that there is a widening field in this commercial territory for the products of American farms and the output of American factories. The United States already has shared in the growth, but there are broader opportunities, and these I have sought to indicate both in the present report and in a number of special reports which it supplements.

The striking features about the west coast as a market are that its purchasing power depends very largely on the exportation of minerals and tropical agricultural products, that it lacks the raw materials for becoming a manufacturing section, and that through this lack of a basis for national industries it must be a heavy buyer of manufactured goods, breadstuffs, and provisions abroad. The development that is now going on in railways and in mines insures a valuable market for iron and steel products in which the United States is preeminent, and it is most gratifying to note the important part which American capitalists are taking in this development. But there is also an increasing demand for other articles, all of which can be supplied by the United States. In addition to the railway and mining enterprises, special note should be made of the possibilities for utilizing the waters of the Andes for hydro-electric power.

I have sought to indicate the countries and the localities in which the different forms of development are most active, so that American manufacturers may know where to look for the sale of their products. It is desirable to know not only the general market but the places where the specific market exists.

To the movement of commodities and the exchange of merchandise transportation is so important that satisfaction will be felt in the

prospective improvement of the shipping facilities between Panama and the west-coast ports. The proposed new steamship line, of which an account is given, will facilitate not only the movement of freight but the transportation of the mails and of passengers. The facilities from the Atlantic coast and from the Gulf of Mexico are fairly adequate, and the tendency of the products of the Mississippi Valley to move through the Gulf ports to Panama and beyond will be encouraged by the enlarged service which is now afforded. In connection with ocean transportation it is a pleasure to state that the sanitary control exercised by the United States on the Isthmus has been of great benefit both to freight and passenger traffic in minimizing quarantine restrictions.

I have not undertaken to give in detail technical information regarding prices and description of articles such as is covered by the special agents who are familiar with the requirements of the separate lines of manufactures. The west-coast commerce has not yet reached the point where it is large enough in its various branches to call for such specialization. But the general facts which are essential to manufacturers and producers are set forth, with suggestions as to the means for following up the opportunities. Practical trade hints are given with a view to aiding American exporters in winning the foreign markets comprised within the commercial area described. Their first step should be to take advantage of the information which the Bureau of Manufactures is able to furnish them. Further steps taken by the manufacturers themselves and continued with intelligence and persistence undoubtedly will enlarge the reciprocal market of the United States and the west coast.

Respectfully,

CHARLES M. PEPPER,
Special Agent, Department of Commerce and Labor.

To Hon. OSCAR S. STRAUS,
Secretary of Commerce and Labor.

TRADE CONDITIONS ON THE WEST COAST OF SOUTH AMERICA.

AREA AND POPULATION.

The commercial area of the west coast of South America includes the 3,100 miles of sea line from Panama to Valparaiso and the country back of it, which consists of the valleys and plains of the intermountain region and the slopes of the Andes system. Its further extension is from Valparaiso to Punta Arenas, a distance of 1,400 miles. The meeting place of the traffic from the Pacific coast of the United States and that which comes from the Atlantic and the Gulf of Mexico across Panama with the traffic around Cape Horn and through the Straits of Magellan may be said to be at Callao, in Peru, midway between Panama and Valparaiso.

The population within this trade area comprises Colombia, 600,000 inhabitants; Ecuador, 1,500,000; Peru, 3,500,000; Bolivia, 1,816,000; and Chile, 3,250,000, or a total of 10,666,000. The statistics relating to Bolivia are based on the census of 1900, and those relating to Chile on the census of 1907; those relating to Peru, Ecuador, and the Pacific district of Colombia are estimates. The total foreign commerce of these countries, including their intercoast trade, while varying somewhat from year to year, may be placed at $260,000,000 to $275,000,000. Of this amount, Chile normally has $140,000,000 to $150,000,000, and in active years much more, the total in 1906 having reached $192,000,000. Of the Chilean commerce, more than one-half is furnished by the nitrate industry. Peru has $50,000,000 to $53,000,000, all of which is west-coast commerce except the rubber traffic of Iquitos that flows in and out through the Amazon and amounts to $6,000,000 to $7,000,000 annually. Bolivia has $32,000,000 to $35,000,000, the bulk of which is through the Peruvian and Chilean ports, and Ecuador has $22,000,000. The trade of the Pacific section of Colombia may be estimated at 10 per cent of the total commerce of that country, or $3,000,000. Approximately, the trade of the west-coast countries is $25 per capita, Chile raising the average.

TRADE CHARACTERISTICS.

The trade conditions in Colombia have been described in a former special report, in which it is shown that the bulk of the commerce is

on the Caribbean Sea frontage, and consequently it does not call for detailed description in the present report. The west-coast part of Colombia is served through the small ports of Buenaventura and Tumaco, the larger volume of business being done through the former. Coasting vessels from Panama touch at both ports on their itinerary to and from Guayaquil. Buenaventura is the port for the Choco gold-bearing region, and the most valuable of its exports is gold dust, though there are a variety of tropical products. The imports are general merchandise, mining machinery, and railway material. Tumaco is notable chiefly for its exports of straw hats. The imports are merchandise and mining machinery.

Ecuador in its relation to the other west-coast countries occupies a somewhat isolated situation. Its leading export crop is cacao, or chocolate bean, which is valued annually at $5,000,000 to $7,000,000. Other exports are coffee, vegetable ivory, hides, rubber, fruits, and some minerals, while among its crops which are consumed at home are cane sugar, tobacco, rice, the cereals, and a limited quantity of cotton. It is essentially a country of tropical agricultural products, with limited mineral resources. The trade conditions of Ecuador have also been fully described in a special report and call for little elaboration now except in their general bearing to the west coast.

Peru, Bolivia, and Chile have many trade characteristics in common, as also physical characteristics. There is a similarity in the projects for developing their resources and there is a noticeable commercial identity, most of the large houses having branches at all the important ports from Paita, in northern Peru, to Punta Arenas, in the Straits of Magellan.

RESOURCES AND DEVELOPMENT.

The physical conditions of the west-coast countries are such that for an indefinite period in the future development enterprises will be necessary in order to utilize their natural resources. Railways are to be built, mines opened up, and public works constructed, so that the commerce is not simply the stationary one of supplying the settled wants of a fixed population. The narrow coast strips between the sea and the Cordilleras may not be subject to commercial expansion, but the lateral valleys, the intermountain plains, and the mountains themselves, which are the storehouses of mineral wealth, are all to be exploited. There is a prospective agricultural development, by means of irrigation, of regions close to the coast and across the Continental Divide on the Atlantic watershed, where railways are expected to join the navigable river regions.

PURCHASING POWER OF MINES AND AGRICULTURE.

The purchasing power of the west-coast countries is dependent chiefly on two classes of articles. These are agricultural, which are

mainly tropical, and mineral products. In Ecuador cacao, ivory nuts, rubber, coffee, and hides are the main source of buying power; in Peru sugar, cotton, alpaca wools, rubber, cacao and cocaine, copper, gold, and silver; in Bolivia tin, copper, and silver, with wool, rubber, cacao and cocaine, and other agricultural products occupying a subordinate position; in Chile the nitrates, copper, silver, wool from the Patagonian and Magellan Straits region, vineyard products, and in some years a surplus of cereals.

Substantially all the mineral products of these countries are exported. Peru's mineral exports are growing rapidly, but a leading source of buying power is still the agricultural products. In 1906 the copper output was 13,000 tons, valued at $15,000,000, and silver to the same amount; the sugar was valued at $4,325,000; alpaca and other wools, $2,600,000; rubber, $2,650,000; cotton, $750,000; hides, $775,000; cacao and cocaine, $250,000.

In Bolivia the mines are both the present and the prospective means of foreign purchases. The output of tin was 17,000 tons in 1906 and 16,000 tons in 1907, the value in the latter year being $15,000,000, as against $18,000,000 in the former year. The copper output was much smaller, but it can be estimated at 5,000 tons annually, with a rising tendency. Exports of silver will increase materially in the next few years.

Chile's production of nitrates, which are used by the whole world as fertilizers, average from $75,000,000 to $85,000,000.[a] The manganese ores, exported for blending, do not furnish a noticeable commercial factor, though they are a valuable asset. Copper, while the production has dropped from 30,000 tons to about 20,000 tons, can still be counted on to bring to the country from $5,000,000 to $6,000,000 annually, and the development of new fields back from the coast, which is now going on, promises to restore the former output. The wool exports have risen to $3,000,000, in response to high prices and an exceptionally active demand.

BASIS OF THE MARKET FOR FOREIGN GOODS.

These products have been grouped in a general way because they exhibit the chief sources of the purchasing power of the countries mentioned and at the same time indicate the prospective lines of development and the nature of the wants to be supplied. It will be found on detailed analysis that the striking feature of the west-coast as a market is the demand for iron and steel products, textiles, and the foodstuffs of the Temperate Zone, for which minerals and tropical products are exchanged. Consequently, there is the natural basis for

[a] The production for the nitrate year ended March 31, 1908, was 41,179,000 Spanish quintals (quintal=101.6 pounds) and the exports were 39,876,000 quintals.

international trade in the exchange of commodities of a widely varying character. As a whole, the west coast has few national industries, and it can not for a long time, if ever, become a home-industry region. The reason for this is that the raw materials which form the basis of manufactures, where they exist at all, are so scattered that to assemble them is commercially impracticable. This is true of Chile in only a limited sense. In its variety of climate, with its temperate-zone products, and in its mineral deposits and forests it has the nucleus of some domestic manufactures. These, however, do not exist in sufficient degree to make it a manufacturing country as distinguished from a producing one whose products are chiefly for export.

LACK OF ORE AND FUEL FOR MANUFACTURES.

The prime factors in modern industrial establishments are iron ore and fuel. Iron ore exists abundantly in Chile, but in the commercial sense the iron-ore fields are yet remote. Much improvement must be made in transportation facilities and great expense be incurred in demonstrating the commercial value and the utility of these deposits. In northern Peru, on the route from Paita to the Amazon, iron-ore beds also exist, but their value is problematical, and even if a railroad should be built to them their utility as the basis of manufactures is doubtful. For a generation at least there is little prospect of the exploitation on a large scale of iron ore on the west coast.

If the ore existed in localities easily accessible, there would still be the basic question of fuel. The development of the coal deposits in the west-coast countries has begun, but as a rule they are located in regions difficult of access, and after railways are built to reach them the mining and shipping charges will render them unavailable except for industries in a circumscribed area. There is, for instance, no point in northern Peru where iron ore and coal could be assembled to build up a great steel mill. The coal that is exploited is used for local purposes and could be further employed for the railways.

COAL FIELDS OF PERU AND CHILE.

Peru now mines between 80,000 and 100,000 tons of coal annually. Some of this in the department of Ancachs is anthracite. Other coal mines have been developed in the department of Junin, which is the center of the bituminous deposits, and the coal, though somewhat high in ash, is utilized by the Cerro de Pasco smelting works, which convert it into coke. The railway extensions from the Oroya district south toward Cuzco probably will result in further output of coal for local purposes, but not for national industries. In 1906 the total value of the Peruvian coal output was $675,000.

Chile for years has mined coal, much of which is lignite and is lacking in caloric qualities. It is commonly known as "stone coal,"

and some of it is used on the steamers. But even if the quality were satisfactory the quantity mined is far from sufficient for home purposes. Heavy importations are made from England and Australia, in 1907 the total having been 1,489,000 metric tons, as against 833,000 tons of domestic production. Recent discoveries in the south around Valdivia have shown that coal of a fairly good quality exists there. The output, however, of newly opened mines is not likely to lessen the importations, since larger quantities are used from year to year. The deposits at present being mined are situated on the southern coast of the Republic, the most important of them extending a considerable distance under the sea. A coal mine is also worked in the territory of Magellanes, near Punta Arenas.[a]

CHARCOAL FOR IRON AND STEEL WORKS.

Chile seeks to employ other natural resources as a partial substitute for coal in building up native industries. Assuming that the iron ore is sufficient and that it can be brought from Coquimbo in the north to the south without transportation charges proving too heavy, the effort is to utilize the big forests of the south in providing charcoal. Liberal concessions have been granted to the Creusot Works, of France, for establishing works at Corral and Valdivia, which are within the forest area. These industries are in the initial stage, and it is not yet possible to predict the outcome of the experiment, but the enterprise will continue to have the support of the Chilean Government by means of both protective duties and subsidies. It is the nearest approach to the establishment of iron and steel industries on the west coast. If the expectations should be realized, Chile at some future time will be manufacturing steel rails, structural steel, black tin plates, corrugated iron, and a variety of other iron and steel products.

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[a] An article in the Boletin de la Sociedad Nacional de Mineria, November, 1907, contained the following statements: "The analysis of the coal produced in the province of Arauco shows that this coal has a caloric value equal to from 92 to 93.8 per cent of the English coal from south and north Wales. A comparison with Australian coal shows results still more favorable to the Chilean product, which is also superior to the best Japanese coal. Finally, it may be said that, judging from the investigations and experiments made both in Europe and Chile with Chilean coal, the superiority of the latter over European lignites has been fully demonstrated." After due investigation it may be stated that there are in the Republic coal deposits that can produce an excellent quality of coke, which may possibly serve for the smelting of iron ores, and which is assuredly suitable for the reduction of some other minerals. An anthracite zone having been discovered in Chile, such as the deposits of Quilacoya and Huimpil, the coal of which contains a large proportion of fixed carbon and very little volatile matter, there is no doubt that the mixture of the products of this zone with certain coals from the coast would produce a good quality of coke.

However, the prospect is not immediate enough to cause apprehension in regard to the loss of this market. In connection with the necessity of cheap fuel for manufacturing industries it has to be noted that even close to the coast coal costs from $15 to $18 a ton, while in the inter-Andean region the price ranges as high as $40 per ton, and is therefore prohibitive. Llama dung and a kind of Alpine moss in the regions above the timber line serve for domestic fuel and for light manufacturing. The moss is also used on railway engines.

The possibility of utilizing crude petroleum as fuel has often been suggested, and as the oil fields are developed a use undoubtedly will be found on a larger scale than at present, but this will be more for transportation than for manufacturing purposes. The output of the Tolara and Zorritos oil fields, in northern Peru, is now about 71,000 tons per annum and the value $1,000,000. The indications are that the fields around Puno and Lake Titicaca can also be exploited commercially, but here, too, the chief use would be for transportation.

NATIVE SMELTERS FOR MINERAL PRODUCTS.

Since mineral products are so important in all the west-coast countries except Ecuador, the extent to which they enter into native industries before they are shipped abroad needs to be described. The description is mainly an account of the smelting industry. In Peru large smelters are in operation for the copper products, and in spite of the high cost of fuel and its transportation charges they are found more profitable than shipping the matte, which is only 60 per cent copper. In Bolivia there are no large smelters for the tin, that mineral being shipped in the form of concentrates. The Pulacayo silver mines at Huanchaca have smelters in operation, but the big smelter and amalgamation works at Antofagasta, which were built at a cost of $2,000,000, also to take care of the product of these mines, were dismantled after a few years' experiment and are now entirely abandoned. In Chile there are several active smelters. The leaching of the Chilean nitrates is so simple a process that it can hardly be called a manufacturing industry, though it is the essential process through which the raw material is put before shipment. A proportion of west-coast cargoes consists of ores for smelting, the freights being based on the London quotations, the cost of marine insurance, etc. In Peru the smaller mines, which are not able to maintain smelters, ship the matte.

COTTON MILLS AND OTHER DOMESTIC INDUSTRIES.

Of industries based on agricultural products the Peruvian cotton mills form the leading one. There are, however, not more than eight or nine mills, with a capital not exceeding $2,000,000, and these do not entirely consume the native crop. Peru is like the United States

in that it raises cotton, ships the raw product abroad, and then buys back the manufactured article. The mills are extending their operations, and in addition to the tocuyos or coarse cloths they are beginning to make bleached goods, yet it will be a long time before the cotton industry of Peru is established on a home-market basis equal, for example, to that of Mexico. Between 1,500 and 1,600 operatives are now employed in the mills.

The straw-hat industry of Ecuador was described in the special report on that country. Its development does not mean any loss to foreign goods, because no other country produces the straw from which these hats are made. Instead this industry, through the prosperity it spreads, increases the market for foreign goods by increasing the purchasing power of the people. Other domestic industries of Ecuador include ship-repair yards, flour mills, breweries, a small sugar refinery, cotton mills, candle works, confectioneries, brick and tile works, and the making of saddlery, matting, and woolen ponchos.

Chile has sugar refineries which might be called national industries. They draw their supplies of raw cane sugar from Peru. It has also locomotive and car works, but these are a local rather than a national industry. This also may be said of the flour mills of both Peru and Chile, of the sawmills, tanneries, and shoe factories of Chile, the brick and tile works of Peru, and the ship-repair yards of all the coast countries. Bolivia is so lacking in local industries that it offers a bounty to those that are operated by steam power.

MACHINERY INSTALLATIONS FROM ABROAD.

The more the national and domestic industries of these countries are reviewed the clearer will appear their dependence on the United States and Europe. Where manufactories are set up, the machinery installation is necessarily from abroad. The smelting works of Cerro de Pasco are supplied entirely from the United States, while the Chilean sugar refineries get their installation from Europe. Peruvian cotton is ginned by American gins and fabricated by Manchester machinery. Such shoe factories as have been attempted base their expectations of profit on Massachusetts shoe machinery. The ship-repair yards and the foundries are dependent on the machine tools imported from the United States. The flour mills all along the coast are supplied with foreign machinery. In addition to the machinery plants necessary for the Chilean nitrate industry there is a market for foodstuffs and clothing.

RAILWAY CONSTRUCTION.

It is apparent from a study of the physical geography of the west coast that internal transportation facilities are at the basis of future industrial and commercial growth, especially in view of the pre-

ponderance of mineral over agricultural resources in so far as relates to commodities for which the most profitable markets may be found abroad. The exploitation of the productive resources and the purchasing power of any locality which may be selected are largely dependent on the extension and maintenance of the railway systems and the operation of the mines.

With this development there is also a growth of permanent population, a spread of general prosperity, and an increase in the purchasing power of the individual. After the transportation facilities are provided, the working of the mines comes. With railway building foremost and with mining exploitation in its wake, it follows that the leading demand must be for iron and steel products, while there will also be a large field for merchandise to be supplied to the railway and mine laborers, as well as to the agricultural population. The wide demand which railway construction creates is well known. There is not only the materials and machinery for the line, but there are the tents of the construction camps and the food and clothing for the workers. This demand, while temporary as to a given locality, is continuous for the different countries as a whole.

PRESENT AND PROSPECTIVE LINES.

A review of the actual construction now in progress and the prospective building would indicate about 300 miles annually for the next five years, with prospect of an increase in the mileage toward the end of that period.

The status of construction in the different countries has already been given in several short reports and in a special report on the progress of the Pan-American project, but in order that American manufacturers may keep advised as to conditions in the region under consideration a summary will be given here.

Colombia.—The Buenaventura line is in operation for 25 of the 80 miles to Cali. An American syndicate is negotiating with the Colombian Government to continue the construction of this railway to Cali and later to Bogota.

Ecuador.—The Guayaquil and Quito Railway, 290 miles, is completed. A feeder south to Cuenca, 92 miles, and afterwards a line north to Ibarra, about the same distance, are projected.

Peru.—Prolongations and extensions include the line of the Central Railway from Oroya south to Huancayo and Southern Railway north from Checacupe to Cuzco. Both projects are being carried out by the Peruvian Corporation under contract with the Government. The line to Huancayo will be extended later to Ayacucho.

The line from the port of Ilo to Moquegua, once abandoned, is being reconstructed by the Government.

Surveys for a coast line from Lima to Pisco have been undertaken by the Peruvian Corporation for the Government. A guaranty of 7 per cent interest on a capital expenditure of $2,500,000 for the 126 miles standard gage was authorized by the Congress several years ago, but the original company failed to take advantage of it.

Surveys for a coast line from Callao to Huacho, 40 miles, have been made by the English syndicate holding the concession and have been approved by the Government. This line is to be prolonged to connect with the narrow-gage systems of northern Peru.

The line from the port of Pacasmayo toward Cajamarca is being prolonged.

A line from Tumbez through the river valley, to be undertaken after the line from the port to the town, 7 miles, is completed, is under consideration.

Projects for railways to the Amazon are awaiting financial backing from the United States or Europe.

Peru has a permanent railway fund, the proceeds of the tobacco tax, which insures continuous railway building. The Peruvian Corporation, through financial arrangements effected in London, has obtained the funds required for the extensive betterments demanded on its system.

Bolivia.—The American syndicate's line from Viacha to Oruro, 128 miles, is completed, and through railway communication now exists between Lake Titicaca and the town of Uyuni, 363 miles. The next construction will be from a point between Oruro and Uyuni to Potosi, and from Uyuni to Tupiza, 125 miles. A later line will be from Oruro to Cochabamba, 100 miles. The gage of the Antofagasta and Bolivia Railway between Uyuni and Oruro will probably be widened from 2½ feet to 3 feet 3⅜ inches, to conform to the American syndicate's standard, and this will call for new material. The joint capital of the Bolivian Government and the Speyer-City Bank Syndicate is $27,000,000, but probably more will be expended. The Argentine Government is making surveys for the prolongation of its line from Quiaca, at the border, to Tupiza, 52 miles. Material for the extension of the Argentine line to Bolivia was bought in Europe.

Chile.—The most important project is the Longitudinal Line, 800 miles, for which the Chilean Congress has authorized the expenditure of $37,000,000. Tenders approximating $20,000,000 were received for the 500-mile section between Papudo and Copiapo.

The line from Arica to La Paz, Bolivia, which the Chilean Government, by a treaty with the Bolivian Government, obligated itself to construct, will be approximately 320 miles long, though complete engineering surveys have not yet been made. The estimated cost is $15,000,000.

Other railway construction is for the Government on the southern lines and for private interests, including the nitrate companies.

AMERICAN RAILROAD IDEAS FOLLOWED.

In a special report on the Bolivian railways the tendency to follow American ideas in construction and operation was commented upon. This is the certain outcome of the introduction of capital from the United States into South American railway building. Heavy locomotives are coming more into favor, 60-pound rails are being laid, and 30-ton freight cars employed.

Except for narrow coast strips, the general feature of railway building in the west-coast countries is the heavy grade and the bridging, which is even greater than ordinarily would be looked for in a mountainous country. A majority of the Peruvian railways are of the standard gage, but outside of these the narrow gage is employed, the meter, or 3 feet 3⅜ inches, being the favorite, though there are some 3-foot gages and one line with 600 miles of trackage has the 2½-foot gage. This is the Antofagasta and Bolivia Railway. It requires pretty heavy locomotives and uses 25-ton cars, notwithstanding its narrow gage.

MATERIAL SUPPLIED BY THE UNITED STATES.

The small quantity of new material and rolling stock on the Buenaventura line, in Colombia, was bought in the United States, and the rails and bridges and rolling stock of the Guayaquil and Quito Railway, in Ecuador, were made in the United States, though there were some minor importations from Germany.

In Peru, though most of the lines are controlled by the London company, known as the Peruvian Corporation, practically all the material, including the ties, is from the United States. Some rails, however, are imported from Europe. The heaviest order for locomotives ever given by a South American railway company was placed by the Peruvian Corporation in the United States. This order was for 55 locomotives. The same company made extensive purchases of bridge material in the United States. Orders and deliveries during 1907 included 200,000 sleepers; 10 bridges for the Central Railway; 15 short girder spans, Central Railway; 1 bridge, Southern Railway; 2 spans, Southern Railway; 2,400 tons rails plus accessories, Chilete extension; 580 tons rails plus accessories for Cuzco extension (additional); 1,500 tons rails, Southern Railway; 7,450 tons rails and accessories, Huancayo extension; 144,000 sleepers, Huancayo extension; 5 bridges, Huancayo extension; 6,200 tons rails and accessories, Cuzco extension; 144,000 sleepers, 55 locomotives, for Central and Southern.

The Cerro de Pasco Mining Company has procured the material for its railway lines almost exclusively in the United States. Its

orders have included engines of the Mogul type, 40-ton steel hopper coal cars, ore cars, box cars, gondolas, etc. In Bolivia up to the present time about 40,000 tons of material, including steel rails, have been bought in the United States by the Speyer-City Bank Syndicate for the lines which it is building under contract with the Bolivian Government. On the lines so far constructed, which are across the central plain and which avoid much of the heavy grading, trestling, and bridge work that will be required in the remaining sections the material required has been from 325 to 400 tons per mile.

HINDRANCES TO CONTRACTS IN CHILE.

In Chile there are well-understood reasons why United States capitalists have not secured contracts for the various railways and why their share in the business of supplying material is relatively small. The controlling influences have European connections, Belgian and German syndicates securing the preference. However, the Government has bought heavy locomotives in the United States for the State railways and also some rolling stock, particularly passenger cars. One order of 60 passenger cars was filled in St. Louis, the price being $8,860 gold each delivered in Chile. A contract for 700 steel freight cars was awarded by the Government in 1907 to a Belgian syndicate, which agreed to lay down the box cars at $1,304 each and the flat cars at $1,823 each. Chile also seeks to favor its local car-building industry.

Some rivalry exists between the German and the Belgian syndicates for the contracts involving the construction of new lines in which the Government is interested.

The contract for the railway from Arica to La Paz was given to the Deutsche Bank, of Berlin. For 500 miles of the Longitudinal Line between Papudo and Copiapo the Belgian syndicate underbid its German competitor by $500,000. The financial arrangements for building these two lines have not at this time been completed, and it can not be said when the construction work will be begun and orders given for material. It is likely, however, that since both of these projects are in the hands of European syndicates the purchases of rails and much of the bridge material and rolling stock will be made in Europe, though it is agreed in South America that both in bridge building and in rolling stock the American mills can do better there than their European competitors.

American firms never have been favored in the large Chilean railway contracts. Usually the announcement of tenders to be made has been within too short a time to permit them bidding. A more liberal policy would be as beneficial to Chile as to railway builders in the United States. The nitrate railways are owned by private companies in which English interests predominate, and their purchases are generally, though not exclusively, made in Europe.

HAND-LABOR ARTICLES—FUTURE IMPROVEMENTS.

One or two additional points in regard to railway material may be briefly set forth. In the construction work there is small demand for steam excavators, while correspondingly there is a larger market for wheelbarrows, scoops, shovels, picks, etc. The salient fact is that about all the excavating and grading has to be done by hand labor, and usually pretty unskillful hand labor. In some places Italians are obtained for the masonry work, while expert bridge builders are sent out from the United States.

In the future air brakes will be fitted to the rolling stock on most lines, though this raises a serious problem in the operation of the railways, since it is difficult to find native laborers who can be trusted with them. A more important fact is the increasing use of the American type, both of locomotives and of cars, which are capable of carrying heavier loads than the local managements heretofore have been willing to attempt. With the employment of American managers on the Peruvian railways and the example set by the American syndicate in building the Bolivian railways, the tendency now is toward the more efficient system, particularly in the freight service.

PUBLIC IMPROVEMENTS.

Harbor works and other public improvements should call for a large quantity of material, now that the Panama Canal is well under way. Some of the Governments, in order to secure the full benefit of the canal, will have to spend large sums, for the west coast has few natural harbors. It is estimated that $60,000,000 will be required to make the necessary improvements in the various ports between Panama and Valparaiso, and the time in which it is calculated that these could be carried out is fixed at ten years. Most of the countries are busied with schemes of railway building for developing their resources, and their revenues, aside from current expenses, are wisely devoted to this purpose. With the development of these internal resources, however, the necessity of improved harbor facilities will become imperative. There will be little gained in exploiting the natural wealth of any country unless means can be found for exporting the products and for receiving in return manufactured goods. International commerce of this sort is the basis of the permanent and the expanding prosperity of all these countries. With the greater political stability which now exists, with small foreign debts, and with public credit strengthened, some of the Governments should be able further to utilize their credit by obtaining reasonable loans for harbor improvements.

TWENTY MILLION DOLLARS FOR VALPARAISO HARBOR.

Chile has been the most progressive of the west-coast countries in providing harbor facilities, and it has something akin to a continuous

policy. The Valparaiso Harbor works, which will cost $20,000,000, have not yet reached the stage of actual construction work under contract. The numerous plans for making Valparaiso a fairly safe port have been described in various consular reports and need not be recapitulated in detail. They have been worked out with great elaboration. At the time this report is written a cable dispatch from Valparaiso says that the French proposal will be accepted and that the works will be completed within five years. There is a Government guaranty of 5 per cent interest to the constructors. With French capital undertaking the enterprise, it is natural to suppose that most of the material will be bought in France, yet in the execution of so large a contract there is certain to be a chance for American material also.

At other Chilean ports marked advances have been made and good harbor facilities have been provided, but the improvements are not concluded and there is an indefinite period for the supply of material. Modern appliances, including improved hoisting machinery, steel cranes, etc., are not common on the west coast, but Chile is better supplied than its neighbors.

MORE DOCKS AND WHARVES FOR CALLAO.

Peru in the near future will be compelled to make great improvements in the dock and wharf facilities which the good natural harbor of Callao furnishes. The shipping is controlled by a French company, which owns and operates the darsena or wharf. This has utterly inadequate means for handling the growing freight. Vessels frequently lie six weeks and longer before they can get their cargo lightered to the darsena, since its limited space is entirely taken up by the regular steamers of the two leading steamship lines. Two railroad spurs are all the facilities that are now available for handling the freight of the railways.

Earnest and indignant protests of shippers and merchants over losses to which they are subjected are daily heard, and the Government is besought to take up the matter. The French company, since its concession is for a limited period, is not inclined to spend money on improvements. At the same time its concession is exclusive, and no other company or firm can erect docking and wharfage facilities. The Central Railway Company, the Cerro de Pasco Mining Company with its heavy shipments of copper, and several of the great business firms are ready and anxious to erect docks of their own if they can obtain the privilege from the Government.

The burden which this condition puts upon commerce is so great that if improvement is not made the whole commerce of Peru will suffer loss. The outcome is likely to be some arrangement by which the French company's concession can be canceled and the darsena

enlarged with plenty of new docks and wharfs and modern hoisting and other appliances. Whether this be done by the Government itself or by throwing open the privilege and permitting the various companies to build their own docks and install machinery, a market for material is bound to be created before long.

At some of the minor ports of Peru improvements also will have to be made. These will consist in building new jetties or extending the existing ones and providing hoisting facilities. At Mollendo, which is next in importance to Callao, costly mistakes are being corrected in building a breakwater, and this work will have to be supplemented by other improvements. At Tumbez and Pacasmayo extensions and enlargements are under way.

PROPOSED IRON PIER AT GUAYAQUIL.

In Ecuador the splendid harbor of Guayaquil, on the Guayas River, is not so perfect that it permits of no improvement. The trouble heretofore has been the sanitary conditions, which made it necessary for the vessels to anchor far down the river and to lighter their cargo. With the hope which is now held out, that Guayaquil will be made a sanitary port, encouragement is given to the scheme for a system of docks and wharves which would do away with the expense of lighterage. This plan has the indorsement of the Government and has been authorized by the Ecuadorian Congress. The legislation provides for an extensive iron pier and wharf and other construction under terms which appear to be reasonable. However, Guayaquil capitalists have not succeeded in effecting satisfactory arrangements, and American manufacturers might be able to float the project by supplying the material through American contractors. The engineering proposition is a simple one.

In the matter of municipal improvements, especially waterworks, there is backwardness, but even the smaller cities and towns are awakening to their importance. Chile has the largest number of small cities and it has proven the best field.

MINING MACHINERY.

The information already given regarding the mineral resources of the west-coast countries and the means which are being provided for their exploitation by the building of railway lines carries its own suggestion as to the market for mining machinery. American supremacy is not so universally recognized in South America as in other parts of the world. A larger degree of recognition in the form of purchases has been given it in Peru than in Bolivia and Chile.

In the mining industry of Bolivia stamps and concentrating tables will be most in demand in developing the tin mines, while the silver and copper mines will call for the usual installations. The reaction

in Bolivia from German machinery may be taken advantage of by American manufacturers. The largest measure of future purchases will be the development of the tin mines and the revival of silver mining in the Potosi and other districts when they are reached by the new railways and cheap transportation is provided. Some of the American companies that were compelled to suspend operations when the financial stringency came on in the fall of 1907 have partially resumed, but the general exploitation of Bolivian mines by Americans, which will be the outcome of the investment of New York capital in the railways and which will insure the purchases of mining machinery in the United States, has not yet begun.

Copper at 12½ to 13 cents a pound in New York, it is claimed, enables the Corocoro mines to be worked, though new ones are not likely to be opened up while this is the prevailing price. To encourage tin exploitation in Bolivia the product must fetch £135 to £140 (£1=$4.86) per long ton in the London market. The copper and silver mines in the Antofagasta district have the benefit of railway transportation within reasonable distance, and that is an encouragement to the installation of machinery to work them.

Smelters of the most modern kind have been built in Peru at Cerro de Pasco and Rio Blanco with almost complete installations of machinery from the United States. Chile has replaced some of its crude works with modern machinery. In most of the mining districts of Bolivia the cost of fuel is prohibitive.

WHERE OIL DRILLS AND DREDGES ARE IN DEMAND.

Oil drilling machinery is finding a growing market, and large shipments are received from the United States. The exploitation of the Lake Titicaca fields is now quite extensively carried on.

Dredging machinery is still a problem, though it is agreed that the placer gold fields are far from being exhausted. In fact, the incentive to the employment of dredges is the belief that they have not been more than scratched. The dredges which were imported into southern Bolivia by way of Buenos Aires to work the bed of the San Juan River have not enabled the company to pay dividends, and the Tipuani River region, where little question is raised regarding the gold deposits, is inaccessible.

In the Inambari region of southern Peru a company is reported to have undertaken to install dredging machinery, allowing two years for its transportation. In the Poto district of the Province of Sandia, after experimenting with traction drills to determine the value of the gravels, an American company has decided to install dredges. In this case there are no serious transportation difficulties to be overcome. In southern Chile it is declared that the dredges have about paid working expenses. In Colombia, where a dredge was brought

in from the Atlantic side through the Atrato River and the expenses of transportation were not heavy, paying results have not been obtained. Nevertheless, many mining capitalists have faith that dredging machinery in time will add greatly to the output of the Choco region. An English company transferred an extensive dredging plant from Burmah to Tumaco on the Colombia coast to work the river bed in that district, but time enough has not yet elapsed to determine the success or failure of the plan.

REQUIREMENTS OF THE NITRATE FIELDS.

The nitrate deposits are the great machinery factor in Chile. It might be said that since the process of breaking up the earth by dynamite or other means, including picks and shovels, carting it to the oficinas, or central establishments, and leaching it is so simple there is not enough call for machinery. There is, however, a considerable use of boilers, since the evaporation is the chief element in the process. There are also the donkey engines which are universally employed, the small electric plants, and large quantities of tubes or pipes for piping the water, which must be either brought from the sea or piped down from the few natural sources where it can be obtained. It is a small oficina which does not require an expenditure of $100,000 for these purposes, while the larger ones expend from $250,000 to $300,000.

During the boom period of 1906–7 the nitrate industry spent great sums in providing machinery, all the leading oficinas equipping themselves with the latest and best. In the stress which came upon the industry at the beginning of 1908 some of them found that they had invested too much on equipment. The consequence of the improvements made and the large purchases of machinery followed by a period of stagnation is that for a few years the demand will be light. Yet the field is worthy the attention of American manufacturers, especially since the United States is buying increased quantities of nitrates and is thus laying the groundwork for a reciprocal trade. Most of the installations of nitrate machinery are from English manufacturers. This is natural, since English capital has controlled the industry from the beginning. After the Germans invaded the field there were some purchases of machinery in Germany also, but these were not large as compared with those from Great Britain.

ELECTRICAL MACHINERY.

The installation of electrical machinery may properly be characterized as one of the future great industries of the west coast. What has been said about the scarcity of fuel explains this prospect, though scarce fuel would not give encouragement to electrical development unless the natural source also existed. This is found in almost unlimited quantities in the waters of the Andes. There is hydro-electric

power capable of indefinite development differing only in different regions. This power already is utilized to a limited degree for lighting, trolley traction, and light manufacturing. From Ecuador to Chile all the larger municipalities have electric lighting, but there are many small towns in which it is yet to be introduced. Its use for private residences, stores, etc., is capable of great extension.

In Ecuador the street-car systems of Quito, the capital, and Guayaquil are being transformed into trolley systems. At Quito the power is near at hand, but for Guayaquil it has to be brought from a distance. A promising project in this country is to bring the power by long-distance transmission from the Chimbo River, 55 miles to Guayaquil, and utilize it for manufacturing industries in addition to traction and lighting.

ENCOURAGING PROSPECT IN PERU.

In Peru the most extensive employment of electricity is that which is obtained from the Rimac River. The chief enterprise is one which brings the power from Chosica, 30 miles, to Lima and employs it for street-car companies, for lighting, and for light manufacturing. Most of the cities have electric-light systems and a few of them also traction systems operated by electricity. In its broadest application—that is, for transportation—Peru offers the most inviting field in the Central Railway, with its 4½-per cent grades and its numerous other engineering problems. The project of operating certain sections of this railway by electricity, so long as neither definitely accepted nor definitely rejected by the Peruvian Corporation, may be said to be open. Many practical railway men and equally practical electrical engineers are confident that ultimately electricity will be adopted.

Peru also offers a prospective field for the utilization of electricity on a large scale in smelting. The Cerro de Pasco Company's investigations of the power available in two rivers 30 and 50 miles distant have predisposed the officials to follow up the subject. No promise is held out of immediate results, yet there is the probability which comes from the economic saving that may be effected in operating the smelters and other works at this great altitude. The Canadian experiments in smelting iron ore, of course, are not conclusive as to copper ores, but they furnish some basis for comparison.

UTILITY IN BOLIVIA AND CHILE.

In Bolivia the first utilization of electricity on a large scale may be in the mining industry. The encouragement comes from the necessity of finding some substitute for the high-priced fuel. Its application to the railway system is a matter of the more remote future; but if the plans of the Bolivian Government are carried out for a railway

from La Paz through the Yungas region to the navigable waters of the Beni River, electricity, in the opinion of competent experts, will be the motive power. Six per cent grades will be required on this line, and they can be overcome by electrical power easier than by any other means.

The use of electricity in Bolivia at present is on a limited scale. La Paz has an electric-lighting system and may install a trolley. The power for the trolley line, which is the continuation of the steam railway from the Heights down to the city, 5½ miles, with 6 per cent grades and sharp curves, is obtained from a gas engine, and with this motor the limit of the cargo that can be carried is 10 tons. The operation of the line is unsatisfactory; and since water can be procured within 20 miles, hydro-electric power will be substituted for the gas engine.

In the Corocoro mining district hydro-electric power can be obtained over a 65-mile transmission, and it is available within a shorter distance of the Oruro mines. The estimated reduction of the cost per horsepower per hour for the mines by the use of electricity is from 3 to 10 cents, according to the location of the mine and the fuel used. Oruro has electric lights, and a few other cities have made contracts for them. Electricity would also be of great benefit to light manufacturing industries, since fuel is so high priced. The Bolivian Government probably would apply the bounty which it now offers to industries operated by steam power to those actuated by electricity should any be established.

In Chile electricity is pretty generally employed, both for traction purposes and lighting, while there is some utilization of this force in manufacturing. The two lines of future development are for manufacturing and railways. The leading project of a railway character is for electrifying the line from Valparaiso to Santiago, but there are numerous other enterprises. An important German hydro-electric enterprise is that for the Maipo River, near Santiago.

EXTENSION OF TELEGRAPH AND TELEPHONE LINES.

In the general sphere of electrical apparatus the extension of the telegraph and telephone systems is to be noted. This is constantly going on. New telephone exchanges are being installed in many cities, while there is a notable tendency toward long-distance lines. The extension of the telegraph lines and the market for copper wire and apparatus is twofold. There is the growth which is due to the building of railways and there is the effort of the different Governments to enlarge their systems so as to bring remote regions in connection with the centers of population. Bolivia, Peru, and Ecuador are all extending their telegraph lines toward the Amazon basin. It is also worth noting that several of the Governments interested have

given concessions for the installation of wireless systems in the vast interior river regions.

The three leading electric companies in the United States are represented in all the west-coast countries and have been aggressive in seeking the business, so that there are few suggestions to be made for the extension of American electrical interests. The chief competition is from the German companies, and this includes telephone and similar apparatus.

MOTOR CARS AND LAUNCHES.

The market for motor cars and automobiles of all kinds, including electrical ones, is confined to a few cities, the lack of good roads making their general use impracticable. The demand for motor boats in the larger ports and harbors of the west coast is limited. In the smaller harbors the prospect is not encouraging for displacing the ordinary boats of the natives, who depend on oars and sails. In Ecuador the river service tributary to Guayaquil offers the best field. Some gasoline and similar launches are now in use, but no electric ones. One difficulty is the keeping of boats in good repair, repainting, so essential in the hot humid climate of the Equator, being a matter of indifference. Farther down the coast there is a better prospect, because wood fuel, which is cheap and plentiful in Ecuador, is dear. Gasoline, kerosene, and naphtha are employed.

A number of motor boats are utilized at Callao and in the adjoining waters. They are very acceptable for harbor purposes. Most of them, however, have been imported from England and Scotland, although there are a few from the United States. This class of boats for whatever locality intended should be of good draft and adapted to rough handling.

AGRICULTURAL IMPLEMENTS.

The market for farm tools is as varied as the differences in soil and climate. In Ecuador it is chiefly for ordinary hand implements, machetes, hoes, sickles, etc., because the mass of the Indian population do not yet use modern implements. The introduction of plows, however, has been followed by favorable results, and they are employed on some of the larger estates. On all the west coast except the central valley of Chile oxen are employed almost exclusively, and there is little probability of a change to horses or mules, because these animals are not available. So the gearing of farm machines must be for slow motion.

POINTS REGARDING PLOWS IN PERU.

In Peru irrigation is so largely employed upon the sugar plantations and the cotton fields that this must be taken into account in

connection with farm machinery. The steam plow in use on some of the larger plantations is of a well-known English make, and it is supplemented in some instances by the disk. For the ordinary purposes, which require the use of the common plow drawn by oxen the expense is great, the estimate being that the animals eat up 10 per cent of the proceeds of the land. For this reason various planters have sought to find a substitute in automobile plows, but they have not yet obtained anything in the latter shape which is suitable for the dry, irrigated soil. Ball-bearing disk plows sell in Lima at retail for $55 to $60. Single-handle steel-beam implements are sold at $7 to $8, and the double ones at $11 to $12.

On some of the lands in the interior region of Peru the crudest and most primitive of all plows is used, not only the wooden beam but the donkey skull as a substitute for steel plates. While the Peruvian natives show the usual unwillingness to change, some dealers are taking means to induce them to adopt modern methods, particularly in the way of actual demonstrations at the hands of intelligent farm laborers who have been shown the use of the implements.

HARVESTERS IN THE CENTRAL VALLEY OF CHILE.

In the central valley of Chile farm implements are very similar to those of the north in so far as the hand tools go. A considerable variety of American plows, cultivators, and harrows, and also scythes and sickles, are in use. There are likewise harvesters, mowers, and reapers. This field has been well canvassed by representatives of American harvesting interests. The conclusion they have reached is that the market is susceptible of a slow but gradual enlargement, dependent on the degree in which machine labor replaces hand labor. At times there is a scarcity of farm labor, and some laborers come from Argentina, the difference in crop seasons making this interchange of work possible. However, there is no farm labor immigration on a large scale, and the use of machinery for harvesting may be depended on as a permanent substitute.

The agricultural-implement business of Chile is centered in three or four large firms with headquarters at Santiago, and there is also a national agricultural cooperative society which has the support of the Government. Some of the American manufacturers regard the Chilean field as an expansion of their Argentine business and manage it from Buenos Aires.

BOLIVIAN DEMAND GOVERNED BY ALTITUDE.

In Bolivia the sale of farm tools is not likely to become extensive for many years or until the chaco or agricultural region on the Atlantic slope is opened up. There is, however, a limited market on the central plain, the average altitude of which is 12,000 feet. In this region the staple products are potatoes, barley, and the cereal known

as quinua, which is similar to rice. In the valleys below 9,000 feet alfalfa, Indian corn, wheat, and oats are grown.

On the central plain, where it is necessary to rotate the crops and rest the soil for periods varying from three to six years, better harvests could be obtained and a shorter period of resting secured by deep plowing. With this idea in view an effort has been made to substitute American plows, including disks, for the primitive wooden prong. The few of these implements which have been introduced have not yet had time to make their way. Bolivia, while limited as a market for plows and similar implements, has, however, one advantage. It is possible to substitute mules for oxen, since large numbers of Argentine mules are imported every year.

HAY AND COTTON PRESSES—THRASHERS AND CULTIVATORS.

There is a good demand for hay presses in Ecuador and Peru and a larger one in Chile. Cotton presses and cotton cultivators are practically limited to Peru, since it is the only one of the west-coast countries that grows cotton in large quantities. The three-prong is preferred to the two-prong cultivator in some of the Peruvian districts. Cultivators which retail at $15 are salable.

Thrashers have not come into general use, though they are not uncommon in the central valley of Chile. In Peru the small, simply operated thrasher is the only one for which a market can be found. The old ways of tramping out the grain by bullocks and winnowing it by the wind are still prevalent in most of the agricultural districts of Ecuador and Peru.

For harrows the market is similar to that for plows, but in many districts the most primitive methods prevail. For instance, in some of the interior regions of Peru the Indian women sit on logs drawn by oxen. An American make of harrow, 50 teeth, and retailing at $35, finds some sale in Lima. A spiked-tooth cultivator retailing at $65 has a more limited sale. English shovels have the preference over those from the United States.

SUGAR AND RICE MILLS.

Sugar machinery is limited to Ecuador and Peru, the latter country being the chief buyer. The majority of the Peruvian sugar plantations are supplied with antiquated machinery, and if modern mills with the latest equipment could be established the economic saving would be important. Nevertheless, even the most advanced and most progressive of the planters are slow to make these changes. They complain that their capital is not sufficient. The machinery in use is of English make, and where new equipment is introduced the English manufacturers get most of the orders. In supplying the trapiches or small sugar mills the United States has a good hold on the market.

Rice machinery is imported both from the United States and Europe. The chief rice fields are in the northern district of Peru, though some is cultivated in the southern section and in Ecuador.

FARM WAGONS AND PUMPING PLANTS.

The lack of good roads explains the absence of a demand for modern farm wagons. In most localities the huge two-wheeled ox cart serves ordinary purposes. Yet there are some American wagons. On the Bolivian table-land the railway company imported for its own use several improved Indiana vehicles, and some of Pennsylvania make are owned by private parties. A sturdy stage coach still employed was built in New Hampshire.

Projects of new irrigation to open large tracts to cultivation are under consideration by the Peruvian Government, and there is a possibility of the installation of pumping plants on a large scale. In Chile the Government encourages irrigation, but there is no general system. The Bolivian Government has no large irrigable areas, but it imports well-drilling machinery from the United States for use on the central table-land. Common pumps for domestic purposes are imported from the United States, as are also windmills, both the common types and the improved æromotors. Southern Peru is the best market for the æromotors.

SUNDRY IRON, STEEL, AND OTHER PRODUCTS.

In machine tools there is a good demand all the way from Guayaquil to Valparaiso. The United States controls it. American drills are found in all the machine shops of the mines and wherever small foundries are established. Carpenters' tools are also mainly from the United States, though there are some from Germany and England. Forges are from the United States. The natives of all the west-coast countries are experts in cabinet work and wood carving and they are accustomed to American lathes and similar tools.

Saws for sawmills are about equally divided, but handsaws are mostly of American manufacture. In this respect a decided preference is shown for the Philadelphia make. Some saws from Alsace imported by Germans are sold in Bolivia, and in Chile there is also a more general use of European tools. In the boom which followed the effort to develop the southern timber field of Chile and which resulted in establishing several hundred sawmills, the trade was divided between the United States and Europe. Most of the lumber used along the west coast is Oregon pine, with a little cedar from Central America. The artisans, being accustomed to this wood, naturally prefer the hand tools which are best adapted to it. American saws and other tools have proven equally adaptable for the Chilean soft lumber. In most of the countries the handsaw is used to a large

extent and the work which in the United States would be done by a small sawmill is performed by hand labor.

NATURE OF DEMAND FOR HARDWARE.

Builders' hardware of American make has large sales at most of the west-coast points, and household hardware has a fair market. The competition, however, is keen—for good quality with Great Britain, and for the cheaper grades with Germany. Hammers are mostly of English make. Locks, bolts, padlocks, and keys are divided between Europe and the United States. In the rural districts the old-fashioned padlock is still the most common in use, while the ordinary door lock with large key is also used. Spring locks are coming into more general use. American wire nails have the preference over German nails.

At the present time there is an unusually good field for builders' and household hardware in Guayaquil, because that city is undergoing reconstruction, and the class of buildings being put up calls for more substantial outfittings than has been customary. American hardware goods are well displayed at Guayaquil. At Lima and Callao also there is considerable building, but here the English household hardware seems to have the preference. In Chile, particularly in the north, there is a large consumption of hardware, but the trade is controlled by Great Britain. Plumbers' supplies and sanitary appliances have a limited but growing market. Silverware is in steady demand in the larger cities where the wealthy and the fairly well-to-do classes are found.

HOUSEHOLD UTENSILS AND GLASSWARE.

Clay and pottery utensils are still in common use among the poorer population of all the west-coast countries, but there are growing sales of enameled ironware. This is mostly from Germany, though some graniteware from the United States finds a market. Glassware has a fair sale in the towns and cities with the exception of Guayaquil, which is a windowless city, ordinary slat shutters serving the purpose of this climate both in the hot and in the rainy seasons. In all the west-coast countries plate-glass windows and show cases are common, but this market, as well as that for common window glass, is controlled largely by Belgium and Germany. Looking-glasses also come from Europe.

Fine glass tableware is imported chiefly from France and Austria. Bottles, of which the importations are heavy, come mostly from Great Britain. The United States does some business in lamp ware and chimneys, a considerable market having been built up by Pittsburg in these articles. Hanging lamps, very ornate, are quite common in the homes of the wealthier classes. They are mostly imported from

Europe. Kerosene is still the chief illuminating agent for the majority of the inhabitants; the poorer classes use candles. The consumption of kerosene is a measure of the market for lamps. It must be remembered, also, that in the Andean region, where the altitudes range from 10,000 feet upward, the atmospheric conditions cause a more frequent expansion and contraction, and consequently a greater breakage than at sea level. Pittsburg manufacturers created a demand for their products by providing a chimney that gave a maximum of durability under these atmospheric conditions.

COOKING RANGES AND STOVES—CLOCKS AND WATCHES.

Cooking ranges are brought from the United States and France, but not in large numbers. The oil stove is used in larger quantities, especially in Chile, where the climate is more severe than in the countries farther to the north and nearer to the Equator. The French gas stove seems to have the preference over the American. The high price of fuel and the reasonable rates at which petroleum may be obtained should increase the sale of oil and of gas cook stoves, as well as those which are used for heating purposes.

In clocks and watches a good trade is done by the United States. Two or three well-known makes of New England clocks are found everywhere, particularly the wall clocks. The finer clocks in the residences of the wealthy classes are imported from Austria and France. High-class American watches are not in great demand, those who are able to buy an expensive article of this kind usually selecting one of European make. In the cheaper grades the American and the Swiss watches compete on even terms and usually are to be found together in the jewelry shops.

Iron bedsteads and portable cots, which are in general use, are imported from England. The demand for brass bedsteads is small.

The sales of barbed wire are increasing in all the agricultural sections, but there is also a steady demand for woven-wire fencing.

TYPEWRITERS AND OTHER AMERICAN SPECIALTIES.

In a large variety of articles which are recognized as peculiarly American it can not be said that the manufacturers in the United States have been lacking in enterprise. Typewriters of every recognized make are pushed, though the limit has not yet been reached. The same is true of cash registers, which are to be found in the interior districts as well as in the cities. Graphophones, phonographs, and talking machines of all kinds are found in the most remote districts. Surgical instruments from the United States have a market, but the American manufacturers have not yet caught up with the French and German makers. Photographic supplies are imported

chiefly from the United States, but not exclusively, since there is competition with cheaper German articles.

The sewing machines are mainly of the prominent American factory which has followed successfully its system of installing machines with families on the installment plan, the first installment covering the factory price. There is some competition by cheaper English and German machines, especially in the interior districts, where the small hand machine has a market. However, these cheap German hand machines are now pretty well discredited. In musical instruments Germany leads the United States.

Printing presses, linotypes, and similar machinery are in growing demand and come from the United States. One drawback is the lack of expert native machinists and operators. In the larger installations of printing machinery a contract usually is made for the services of an expert machinist for a given period.

Cutlery is divided between England and Germany, with very little from the United States. Firearms are imported mostly on Government account, generally under contract, but there is a fair sale to individual customers, and these show a preference for American revolvers. The German imitations of American firearms, which were sold very cheaply, are now in disfavor, their inferior quality having quickly shown itself.

BUILDING MATERIAL.

Among the iron and steel products outside of heavy material, such as steel rails and machinery, probably the largest single item is corrugated iron, both for sheet-iron roofing and for other building purposes. Its use is universal. The whole nitrate district of Chile is a collection of corrugated iron cabins and other structures. This material is as easily fabricated into the dwelling of the peon in the desert as of the town residence and store and seems to be preferred to the mud or adobe cabin. It is also in use for larger structures, as in Antofagasta and Iquique, where the churches are of structural steel and corrugated iron. The capital city of La Paz, in Bolivia, which formerly was a city of red-tiled roofs and which has had a decided building boom, is now a city of sheet-iron roofing, this material being used on all the new buildings. In Ecuador in many places the grass-thatched roofs are being supplanted by sheet-iron ones, no recourse being had to the tiles as an intermediate stage.

VALUE OF THE MARKET FOR CORRUGATED IRON.

These illustrations give a general idea of the increasing value of this market and of its permanency. Since the mills in the United States can make corrugated iron more cheaply than those of Great Britain it is a source of surprise that so much of these importa-

tions should be from England. The explanation appears to be that while the United States can produce corrugated iron cheaper than England the latter can ship it at lower rates.

An example of the difference in prices was noted in Peru. A large mining company asked bids for painted corrugated iron in lots of 500 tons. The quotations c. i. f. Callao per ton of 2,240 pounds were as follows: From Liverpool, via Panama, $54.62; via the Straits of Magellan, $54.02. From New York, via Panama, $56.18; via the Straits of Magellan, $54.50. There was thus a difference in favor of the English product by either route, but on account of transshipment the Straits are preferred. The explanation offered by the importing house which made the tenders was that the English firm had the benefit of competition between steamship lines. Moreover, when the rates of the steamers were too high the English firms utilized sailing vessels, and with the sailing vessels to fall back on they always could be sure of a means of regulating the steamship rates.

This corrugated iron and similar business is so important that a new steamship line, or rather an existing line whose vessels heretofore have limited their itinerary to the eastern coast, is now running to the west coast as far north as Callao. It is understood that this line has a guaranty of a certain percentage of cargoes from powerful iron and steel interests in the United States. The shipping facilities afforded should enable the United States mills to obtain a larger share in the sales of corrugated iron and affiliated products on the west coast, since the announced purpose of the American manufacturers is to lay down their goods c. i. f. on the west coast on terms to meet any rates that may be offered by competitors.

RELATIVE USE OF STRUCTURAL STEEL AND CEMENT.

The relation of corrugated iron to building, as thus briefly outlined, does not deprive other building material of a market. American manufacturers after the Valparaiso earthquake looked forward to an immediate market for building material of an antiearthquake character. It can not be said that the makers of structural steel, cement, etc., neglected to cultivate this field. Representatives of several large concerns visited the country. Some of them were disappointed, but it can hardly be said that their disappointment will be permanent. Chilean imports of cement increased from 50,227,000 kilograms (kilogram = 2.2 pounds) in 1906 to 98,423,000 in 1907.

There was not the resort to structural steel on a large scale which had been anticipated. Rebuilding began in Valparaiso and other points within the earthquake zone with a view to protection from earthquake, but the processes employed were simple. In the large buildings the cement work was reenforced by steel for the heavy framework. In ordinary dwellings bamboo poles and other reeds

were wired and then plastered with mud. The natives still use adobe or clay and sun-dried bricks with the interstices filled in. At several places along the coast where structural steel was employed it was not usually of American make and the building scheme was faulty, as happened in Lima, Peru, where the most pretentious new building in the center of the city is of poor Belgian structural steel and the structure itself is of the bird-cage type.

NO ENCOURAGEMENT FOR SKY SCRAPERS.

American representatives probably looked for too much, some of them expecting sky scrapers to be erected, at least 6-story buildings, on the same scale as in the United States; but it is difficult to induce the construction in any Latin-American city of a building even for business purposes of more than three stories. The use of cement has been greatly extended and some of the best quality is imported from the United States. The cheaper grades can not be exported by American manufacturers profitably in competition with Germany and Belgium.

Reenforced concrete, as it is understood in the United States, is not coming into general use, but a cheaper form of cement is being substituted for it. The city of Guayaquil is going to be rebuilt on sanitary principles and there ought to be some use there of structural steel and of similar material. Expanded metal is being introduced into Peru with satisfactory results, and its use is likely to spread along the whole coast.

LUMBER IMPORTED FOR MANY PURPOSES.

The west coast market for lumber from the United States is an unusually good one, Chile and Peru rarely falling below $1,000,000 each in their annual importations. This lumber is used for building purposes, for the mines, and for railway ties. A large quantity, for instance, is employed in the Cerro de Pasco copper mines. The bulk of the railway ties used is also from north of Panama, though some are supplied from southern Argentina and Chile.

While all the countries have extensive timber resources, in most of them the lack of transportation facilities renders these resources useless, and it will be many years before the railroads are built to the timber regions and the various countries become independent of lumber brought from abroad. Chile is exploiting her great forests in the south, but on account of its great dampness the quality of this timber is poor. For building and similar purposes it does not compare with the North American lumber, as the Chilean imports from the United States show. At Lima, through which all of central Peru is supplied, Oregon pine commands two and three times the price paid for Chilean lumber. In the nitrate districts some light cork wood is

brought from Ecuador for special purposes, but Ecuador itself is an importer of North American lumber.

POPULARITY OF AMERICAN FURNITURE.

Some native woods are manufactured, yet the bulk of the household and office furniture is imported. American manufacturers heretofore seem to have paid little attention to this west-coast field, their shipments being spasmodic and to fill occasional trial orders. However, Peruvians, Ecuadorians, and Chileans who have been in the United States have by their own initiative and through their preference for American furniture created a good demand. American styles appear to suit them. Wickerwork is popular, while Austrian bent-wood chairs are less common than in other parts of South America. Roll-top desks and office appliances are from the United States, but there are many business houses which confine themselves to old-time plain desks, some of which are of native manufacture. There is a market for modern school furniture, and manufacturers would do well to get in communication with the municipalities which provide for public school systems.

MARKET FOR TEXTILES.

Next to iron and steel products the most valuable market on the west coast is that for textiles, and of these cotton piece goods are naturally the leader. Notwithstanding that wool is the product of all these countries and that the art of native weaving has not been lost by the Indian populations, they are very far from clothing themselves with materials of home production. There are a few native woolen mills. The textile market may be estimated approximately at $12,000,000 to $15,000,000 annually, of which Ecuador imports $1,500,000, Peru $3,000,000, Bolivia $1,250,000, and Chile $7,000,000.

Chile buys heavily in the United States of drills, shirtings, and flannels. The Peruvian cotton mills are yet far from supplying the native demand for the tocuyos or coarse goods of their own people, and they contribute only slightly to the Bolivian market. This local production has had some effect in diminishing the call for imported gray domestics, but it has not been seriously felt. The Peruvian mills also manufacture some drills, ducks, cashmeres, and towels. Manchester prints have almost a monopoly in all the countries of this class of goods. The United States sends unbleached goods, some drills, gray domestics, shirtings, and duck, and also colored prints in small quantities. Italy, through the presence of an Italian population, has obtained a foothold and exports some bleached and colored goods. Germany supplies shirtings, but its best trade is in hosiery. It also supplies ponchos in imitation of the native manufacture.

WOOLENS AND WOOLEN MIXTURES—HATS.

In woolens and woolen mixtures the market is divided between England and Germany, the former having the bulk of the trade in blankets and the latter in shawls, a variety of shoddies, and in ready-made clothing, for which there appears to be a growing market. Silks and fine dry goods are divided among France, Germany, and England, although there are some direct silk importations from China and Japan. Linens are from England, Italy, and France. Collars and cuffs have a larger mixture of cotton than of linen, and this trade is supplied chiefly by Italy and Spain, which understand its peculiarities and cater to the demand for very high turn-down collars and for expansive cuffs. Haberdashery may be said to be controlled entirely by European houses. In neckties the demand is for very fancy articles, and the fine grade is from France and Italy, while Germany supplies the cheap and gaudy neckties, as also the handkerchiefs.

The demand along the tropical belt for foreign hats is surprising when it is considered that light straws are more suitable. The Panama hat even at Guayaquil, which is the center of the market, costs almost as much as in New York and is little worn except by foreigners. The extent to which black derbies are worn in the Torrid Zone always astonishes a stranger. This is a valuable market and is supplied by England and Germany. Tall hats are also in quite common use and most of them are imported from London. Felt hats, both black and white, are in fair demand. A few American hats of this class have found their way south from Mexico and Central America, but the greater number are of European make. The cheap felt hats worn by the poorer classes are of Austrian manufacture, other countries not being able to compete. In the interior, particularly in Bolivia, the Indians of both sexes wear this felt headgear.

UNITED STATES WEAK IN COTTON PIECE GOODS.

The manner in which the cotton-goods market has been allowed to fall away from the American mills was described in the report on Ecuador and in special reports. The loss has been largely due to indifference caused during periods of active home demand and to the enterprise of the Manchester mills in supplying the deficiency. It is difficult to point out a remedy for this condition until the American cotton mills themselves wake up to the situation and decide that this business is worth going after again.

The cotton-goods trade differs from almost every other line of foreign business in the lack of intercourse between the mills and their customers. Other kinds of manufactures are pushed by means of catalogues and printed matter, samples, and traveling salesmen. This method appears to be almost unknown in cottons. I have heard

of only one traveling salesman on the west coast. The importing firm generally buys from the manufacturers' agents or through the commission agents. They quote prices and indicate what they are ready to supply, occasionally also offering to shade current quotations on a job lot, which is usually a case of dumping. They answer queries, but apparently seldom urge sales or offer to meet local conditions by supplying special patterns and designs. They also show indifference to the metric measurements, which the Manchester mills readily place on the factory output when required.

The means of regaining this market would seem to be for a number of mills to act in concert and select a representative who would spend his whole time traveling from commercial center to commercial center and bringing the importers into direct communication with the mills. Usually Massachusetts staples are understood by the term American cotton goods, the southern mills not being known. Some of the southern mills which have gotten into Central America could extend their trade down the west coast.

LEATHER GOODS.

American boots and shoes were received with great favor on their introduction into this market, and the possibilities are far from exhausted. Nor is it seriously restricted by high import duties for the protection of local factories. The fact stands out that American shoes of good quality can be sold in competition with those of native manufacture because their superiority makes itself felt. The retail price usually is from 75 to 100 per cent above the price in the United States. The well-to-do classes are able to pay this and they are fully supplied with American shoes. The problem for the exporting manufacturer is to secure the sale of shoes for the poorer classes at figures within their means, and the first step is to convince them of the saving which is effected through durability. It is the common knowledge of dealers, if not of buyers, that a pair of good American shoes will outlast two pairs of native ones. In Ecuador and Peru most of the local shops, many of which are hardly more than cobbler shops, use imported tanned leather, but it is not of the best quality.

In Chile the tanning industry at Valdivia was established by Germans fifty years ago, and is still in their hands. It therefore furnishes a basis for leather goods which the other countries lack. A national shoe and leather exposition was held at Santiago in the fall of 1907, at which 23 shoe factories and tanning establishments were represented. Their daily output of boots and shoes was stated to be a fraction under 6,000 pairs. While Chile thus has the basis for shoemaking, and while some of its factories are equipped with American machinery, they are still restricted largely to the coarser grades. The quality of the native tanned leather is poor. It is also claimed that

American tags are put on these inferior goods to deceive customers. The foreign population, which is considerable, buys largely of imported shoes.

SOURCES OF COMPETITION.

In Peru there are no large factories. A number of American manufacturers have established agencies, and their output is sold on commission. A few stores in Lima make a specialty of American shoes. An effort which was made some years ago to establish a distinctive New York shoe house failed, yet it served the purpose of making American shoes known. There is a better prospect now for a similar experiment. It must be noted, however, that Vienna is beginning to compete with the United States in shoes of a quality a little above the average. Though the last which is shaped to the foot is not yet popular, the disappearance of the very sharp pointed toes is noted. Ladies' fine shoes come from both France and Spain. American manufacturers do not appear to have pressed the sale of this class with the same success that has marked men's footwear. The popularity of russets and tans is also noted.

In Bolivia the market is still a restricted one, but is being slowly expanded as a larger number of Americans spread through the country. The fine, high-laced shoe, usually of gilt or silver surface, which is worn by the Indian women and costs $12 and upward, is manufactured by hand or is imported from France. In Ecuador the United States has the lead in men's shoes of a good grade, but lacks in supplying children's shoes of a good quality. The poorer classes wear alpargatas, or straw sandals, some of which are of native manufacture and some of which are imported from Spain.

In saddlery, for which there is a good demand in all the interior regions, the English manufacturers lead where reliance is not had on native work. A small raw-hide trunk, known as the "petaca," which is in universal use in mountain traveling, is of home manufacture, but there are considerable importations of trunks and valises from England. Small quantities of fine leather goods, pocketbooks, ladies' handbags, and small satchels are imported from France.

BREADSTUFFS AND PROVISIONS.

The west-coast countries are so far from feeding themselves that the importation of breadstuffs and provisions forms a large part of their foreign commerce. Chile is the only one which might be called self-sustaining in the matter of flour, and even it makes importations for blending, taking both flour and wheat from California. The production of cereals in Ecuador is limited to isolated districts, which have the crudest and most primitive kind of flour mills and supply only the neighborhood. Peru has some good agricultural districts, but they are isolated and without means of transportation. The large

flour mills are located on the coast at Callao and approximately 40,000 tons of wheat are yearly imported for their consumption. Sometimes a little of this is from California, more from Chile, and a larger quantity from Australia. The flour industry at Callao is an important one. The largest mill has a working arrangement with the Chilean mills. There are also a number of mills controlled by Italians, which in addition to flour, manufacture vermicelli, macaroni, and other wheat pastes.

NATURE OF FLOUR IMPORTATIONS.

Under these circumstances heavy importations of American flour hardly can be expected, yet there is a permanent market, since the native mills need the American flour for blending. Peru's annual importations of wheat and flour from the United States amount to $400,000. Ecuador takes annually flour from the United States to the value of $300,000, much more than is taken from Chile. The Bolivian market is the prize for which both the United States and Chile contend, since practically all the flour it consumes has to be imported. Notwithstanding that Chile is so much closer, some direct shipments are made from the United States through Mollendo. Chile ships through the port of Antofagasta. A tribute to the California flour is the adoption of the name "Californian flour" for one of the Chilean brands. Some of the Bolivian importers blend the Californian and the Chilean flour after importing. There is no longer a tariff discrimination by Bolivia in favor of Chile, and American flour is imported by the former country though it does not appear in the customs statistics.

As regards cereal products other than flour the market can not be said to be a big one, though it should not be neglected. Indian corn is imported by the different countries in variable quantities, usually in the form of corn meal, which Ecuador purchases to the extent of $75,000 to $100,000 and Peru and Bolivia in lesser quantities.

LIMITED DEMAND FOR BREAKFAST FOODS.

Efforts to create a demand for the various kinds of breakfast foods have met with some encouragement in proportion to the degree of energy shown, yet this market never can be an extensive one, since tropical countries are not suited to them, and tropical customs extend to the higher regions where the climate is not torrid. The drawback to an extensive use of breakfast foods is that in the Latin-American countries no breakfast is taken according to the American idea. Among all classes the morning meal consists of coffee and rolls or simply coffee. The midday meal is a substantial one, beginning with soup and cold meats. Rice serves as a substitute for cereals. There is, however, among foreigners and natives who have lived in the

United States an occasional demand for oatmeal porridge, and oatmeal is handled by the grocers in preference to the other breakfast foods. Another drawback is the difficulty of obtaining fresh milk, but this is partly overcome by using condensed milk and cream properly diluted. The different sorts of English " biscuits " are in general use among both foreigners and natives. American soda crackers are rarely obtainable.

LARD AND COTTON-SEED OIL.

Under the heading of provisions the most important item is packing-house products. The hog of the coast region and of the mountain plateaus is of the lean, razor-back variety, and is not a lard producer. The importation of lard is therefore quite heavy, the bulk of it coming from the United States. Ecuador buys lard to the amount of $350,000 annually, Peru $250,000, Bolivia $100,000, and Chile $250,000. The latter country, however, obtains some of its lard from Uruguay. Cotton-seed oil and similar preparations, and also olive oil, are used, though not much of the pure olive oil is imported. The cotton-seed oil importations from the United States are small, except in Chile, because Peru itself produces the article and helps to supply the neighboring countries. Some cotton-seed oil of the United States, however, finds its way to the west coast from Europe. The Peruvian cotton-seed oil is used for lighting purposes in some of the mining districts and for the manufacture of soap. The oil-cake residue is exported to England. There are some importations of bacon, but hams are more in demand. Few of these come from the United States, the Spanish and English hams having obtained the market years ago.

TINNED MEATS AND CANNED FRUITS.

In tinned meats of all kinds the market is a most valuable one and its permanency is assured, since large districts in the interior must depend upon this source of food supplies. In the mining regions of Peru and Bolivia and in the nitrate districts of Chile there is an enormous consumption of tinned meats, and the trade has spread to the far interior rubber regions since an American company succeeded in opening up trade with them by means of a special steamer.

Soups and a variety of other tinned goods are imported from the United Kingdom, notwithstanding the enterprise which Chicago packing houses have shown in looking after this trade. Sardines are almost entirely of European shipment.

Canned salmon also forms a valuable trade, the bulk of the importations being from the Pacific coast. A possible limitation on this market is indicated in Chile, where an effort is to be made under the sanction of the Government to propagate salmon. The Chilean waters are declared to be suitable for this purpose. Chile now buys

canned salmon in the United States to the amount of $200,000 annually,[a] and it will be several years before the demand will be lessened by the propagation of native salmon, even though the experiment is successful.

In relishes, pickles, and preserves, England has control of the trade, though fine French preserves are in evidence. In most classes of canned fruits, which is an extending trade, California has the lead. In many places Swiss condensed milk has the lead over that from the United States.

FOREIGN AND NATIVE BEVERAGES—MINERAL WATERS.

As regards beverages and liquors there will always be a market, notwithstanding the native wine production. In the Ambato district of Ecuador vine cultivation has been attempted with some success, but only a small neighborhood district is supplied. In Peru the Pisco and Moquega districts make a fair article of wine, but the consumption is not great. The Pisco brandies have an established reputation. Chile is the real wine-producing country of the west coast. The products of its central valley vineyards are in favor, though they do not shut out the clarets and other imported French wines. California clarets have not undertaken to compete with Chile. American and Scotch whiskies are imported in about equal quantities.

All the countries produce barley and occasionally hops, so that local breweries are everywhere to be found. Usually these are flourishing local industries, yet they do not seem to interfere with the importation of foreign beers. Preference is shown for German beer, yet the light bottled beer which some of the American breweries export finds a ready demand. The market would be greater were it not for the persistent bad packing of the American breweries, which causes the local dealers to forego orders. English ales have some demand, but sales are small in comparison with beer.

There is a universal market for mineral waters, notwithstanding that most of the countries have mineral springs of their own and bottle the product under various names. A well-known brand of American mineral water is now successfully competing with Apollinaris.

DRUGS AND MISCELLANEOUS SUPPLIES.

American dealers in drugs and medicines should understand the new condition which is enlarging the west-coast market. All the Governments are giving much more attention than formerly to sani-

[a] The exports of canned salmon from the United States to Chile for the fiscal year 1907 were $286,000, according to the returns of the Bureau of Statistics.

tary measures. The permanence of the bubonic plague has been reluctantly recognized and measures taken to combat it continuously instead of spasmodically. The serum used is imported from Paris. Some of the Governments until recently took no account of smallpox, but they have now taken it in hand and have adopted compulsory vaccination. They rely on Paris for the vaccine matter.

Disinfectants are in universal use, notably at Guayaquil, since the violent outbreak of bubonic plague in the spring of this year. Disinfecting apparatus is employed on all vessels coming through the Straits of Magellan when they reach Peruvian ports. Standard drugs are slowly displacing patent nostrums, though the makers of some of the latter started a fresh campaign when the pure-food law in the United States restricted their operations at home. One large American house has built up an excellent business in supplying standard prescriptions, but there seems to be ample opportunity for other houses. Emulsion oils, of which the consumption is large, are handled generally by local branches of the American establishments. Both Germany and France do a large business in supplying medicinal preparations. Millions of oboles, or wafers, are imported from France for quinine preparations, these wafers being employed instead of capsules. Gauze bandages, absorbent cotton, and various antiseptic preparations are supplied by France.

There is a valuable trade in fine soaps, perfumes, and toilet preparations, in which the United States has a share that could be made larger by proper effort. The American manufacturers of these articles appear to understand how to put them up attractively, and that is one of the best means of securing sales.

PAINTS, WALL AND FLOOR COVERINGS, AND PAPER.

It is doubtful if American makers of paints and varnishes take full advantage of the market which they could obtain, though they do better with varnishes than with paints. The heat and humidity of the tropics make frequent painting a necessity, and this demand is a constant one. German dry paints are bought in preference to those of the United States, and the Germans also have the trade in dyestuffs.

In wall paper, lincrusta, linoleum, and oilcloths there is a limited sale, but this market could be extended. It is very stable, since new patterns are not required each year. Such trade as exists is in German hands. The Germans also control the trade in stationery, both in the ordinary grades and the finer qualities, and in wrapping paper, though there is some competition from Great Britain. The only market the United States has is in supplying printing paper, which it does in large quantities.

Practically no competition exists in the importation of petroleum from the United States for illuminating uses, since little of the Peruvian products is refined for this purpose. The same is true of lubricating oils.

FISCAL SYSTEMS.

Without reviewing the fiscal systems of the different countries in detail, it may be said that in addition to the usual means of internal taxation—alcohol and tobacco in particular—and the import duties, exports are a leading source of revenue for all except Peru. Chile draws large sums from the export tax on the nitrates, which is 56 cents gold per hundredweight. Bolivia's heaviest source of revenue is the export tax on tin, but it also draws from silver, copper, and bismuth and from rubber, which is the leading agricultural export. Ecuador's products being almost entirely agricultural, the export duty is levied on cacao, vegetable ivory, and rubber. Peru levies a duty of 3 per cent on gold in bullion or dust and about 4 per cent on rubber.

PRINCIPLE OF CUSTOMS DUTIES.

The customs principle as applied to imports by all the countries is nominally ad valorem, but actually in most cases the duties are specific. Articles are divided into various classes at different ad valorem rates, but there is a valuation schedule fixing the value of almost every article named in the schedules. For example, the invoice value of a shipment of shoes from the United States is not taken as it would be declared by the exporter. Instead there is a classification in dozens of the various kinds of leather goods and the shoes are placed under their proper classification and the duties levied according to this schedule. Railway material, mining machinery, and agricultural implements are, as a rule, admitted free of duty.

In Chile payment of customs duties may be made in paper money valued according to the international rate of exchange. In Bolivia it may be made at the current rate as fixed by the Government. In most of the countries the duty is also levied on gross and on net weight. Information regarding the tariff systems and the latest changes in the schedules is always to be had from the Tariff Division of the Bureau of Manufactures. The metric system is in universal use, and the weight is usually given in kilograms.

ECUADOR'S APPLICATION OF SINGLE STANDARD.

The financial systems vary, but there is little difficulty in conducting commercial operations. Ecuador and Peru have the gold standard and are subject only to the ordinary fluctuations of exchange. In Ecuador the banks are allowed to issue paper notes against a gold reserve of 50 per cent and a silver reserve of 10 per cent. Values

usually are measured in terms of the sucre, which is equal to 48.7 cents American gold. Both silver and paper sucres are in circulation.

The basis of value is the gold condor, equivalent to the English pound sterling, but in actual business the pound sterling is the gold coin in use. It is legal tender for customs payments and for all Government obligations. At times sovereigns are imported from England, some of them by way of New York, in considerable quantities, though nominally there is a slight balance of trade in favor of Ecuador due to the heavy sales of cacao in the European and the New York markets.

Ordinary commercial discounts are 8 per cent. International exchange is conducted on the basis of ninety-day drafts against London, Paris, and Berlin, or sixty days against New York. Commercial drafts of this character with the bills of lading attached differ greatly in the premium according to the season and the prevailing movement of exports, the premium ranging from 1 per cent to as high as 2½ per cent. For three days' bank drafts on New York or London the charge is from one-half to 1 per cent. Ecuador has a number of strong banks with headquarters in Guayaquil. Their dividends through several years have ranged from 12 to 15 per cent.

PERU'S COMMERCIAL STABILITY UNDER GOLD.

Peru mints its own gold, the standard coin being the inca, or Peruvian pound sterling, which is the exact equivalent of the English pound sterling. The latter also is in circulation, and heavy importations are made from time to time. The most common coin is the silver sol, 10 of which make a pound sterling and the value of which, in terms of American gold, is 48.7 cents. No paper notes are in circulation, their emission being forbidden by law. For this reason checks form a larger element in the current commercial operations of Peru than in the neighboring countries. Ordinary discounts for commercial business are 8 per cent.

In shipments abroad ninety-day drafts against documents is the usual time and three-day or sight drafts in limited transactions. The premium varies, but the rate of exchange, on account of the stable monetary system, is never violently disturbed. Some shipments of sugar and cotton are made against documents, but the banks do not encourage this business. On imported goods thirty-day drafts are accepted, though many shippers secure longer time. Advances are made to some of the exporters of ore, who in their turn make advances to the producers.

All the Peruvian banks have increased their capital during the last few years, and there is still, in the judgment of Peruvian financiers, room for the expansion of banking capital. The railway companies, which are under English control, and the big American mining com-

panies bring gold into the country to provide for the payment of wages and running expenses.

BOLIVIA'S ADVANCE FROM SILVER BASIS.

Bolivia aspires to advance from a silver basis to the gold standard, but has not yet reached it. Legislation has been enacted providing the ratio of the country's currency to foreign gold, and it is hoped in time to secure a sufficient quantity of gold to enable the transition to be made. The present currency is paper and silver, the common coin being the boliviano, equal to about 40 cents American gold. Some silver money is in circulation, but the bulk of the transactions are in paper notes. These are issued by the banks under the authority of the Government and against a fixed reserve. Not enough of these notes of small denomination are issued for common purposes, and within the borders of the country half bills of the denomination of $5 and downward are used. The loss from this mutilation is serious, and it is also an inconvenience, but no means have yet been found for overcoming it. The Government seeks to maintain a parity of international exchange on the basis of 12 bolivianos to the pound sterling, and it has done this through several financial crises with a fair degree of success.

There is an export duty of 3 per cent on the exportation of gold coin. In the stringency in the spring of 1908 the Government issued a decree prohibiting absolutely the export of gold coins, except a small amount for personal use. Whether this resulted in increasing the contraband, as was claimed, is uncertain, but it stopped the operations of some of the banks which were exporting gold to Chile. The gold in use and which is held by the banks consists both of English and of Peruvian pounds sterling.

Commercial drafts on London and Hamburg are usually for ninety days, with a premium sometimes as high as 2 per cent. Ordinary bank drafts at three days' sight are at 1 per cent. When the tin market is active and a good price is had in London, Bolivian exchange is fairly steady.

CHILE'S FLUCTUATING PAPER CURRENCY.

Chile, notwithstanding its mineral and agricultural resources, presents the greatest uncertainty in international operations, and in the panic of the last year losses by business houses were heavy. There are 150,000,000 paper pesos or Chilean dollars in circulation. In 1903 a law was passed providing for resuming the gold basis on January 1, 1910. Subsequent to the passage of this law fresh emissions of paper notes were made and there was some increase in the national debt by means of floating loans. This is said to have undermined confidence and to have been the cause of the panic. While it undoubtedly contributed, overspeculation was another cause. However, the conse-

quence was the same. Exchange, which for several years had been falling, dropped rapidly until the peso was quoted at 9d. This was a severe loss as compared with 1905, when it was 18d. Some bank suspensions occurred and all business was violently disturbed by the daily and even hourly fluctuations.

Chile has not yet fully recovered from its panic, but its natural resources are so great and its experience has been so bitter that it may be counted on by legislation and by greater conservatism in business operations to get back to the normal basis. During the crisis it resisted the tempation to call in the gold conversion fund from London and New York. In foreign trade the practice is to draw for value of invoice at ninety days' sight on receipt of goods payable at ninety days' sight rate for bills on London.

FOREIGN AND NATIVE BANKING CAPITAL.

The banking capital on the west coast is divided between native and foreign capital. Except one at Quito, in which Americans are interested, the Ecuador banks are controlled entirely by native capital. In Peru the Bank of Peru and London is, as its name indicates, a joint affair. It has branches throughout the country. The Banco Aleman Trasatlantico opened in Peru in 1905, when it took the Government loan of $3,000,000. It has branches at different points. The Italian Bank of Lima limits its operations to that community, but there is also an Italian bank at Arequipa. The Banco Internacional del Peru has its headquarters in Lima, as has the Banco Popular.

In Bolivia the National Bank, with headquarters in Sucre and with branches in the various cities, is the fiscal agent of the Government. Other banks, however, occupy a somewhat similar relation and issue notes. It is only since 1905 that foreign capital has come into the country. The Banco Aleman Trasatlantico opened branches, as did the Bank of Chile and Hamburg. The Bank of Peru and London secured authority from the Bolivian Congress to engage in business on the same conditions as the other banks, but under the name of the Bank of Bolivia and London. The Bank of Tarapaca and Argentina, under its new name of the Anglo-South American Bank, has also established branches in Bolivia.

In Chile native capital occupies a more prominent position in the banking institutions than is the case with the other countries except Ecuador. There are some banks whose capital is almost entirely local, while there are others in which English or German capital is joined with Chilean capital but in which the control is really held in Europe.

PROSPECT FOR AN AMERICAN BANK.

The advantages of an American bank on the west coast frequently have been set forth in reports by consuls, notably by Consul-General

Winslow, of Valparaiso. The increasing investments of American capital would seem to be a sufficient inducement. The big American mining interests in Peru do their business mostly through the German bank. Similarly, the syndicate which is building the Bolivian railways banks through the same institution. Substantially all the business has to be done by way of London. During the wild fluctuations in 1907 in Chile it cost from 12 to 14 per cent more for New York drafts than for those on London. This was because the merchants had to clear through London. It is likely that besides advancing and facilitating trade an American bank would return good interest on the capital invested.

TRADE ANALYSIS.

The commercial relation of the United States to the west coast may be seen from a statistical summary for the calendar years 1906 and 1907. The trade exceeds $50,000,000 per annum and there is a balance in favor of the South American countries. Colombia is omitted, since it is not possible to give the correct total of the importations through the two small Pacific coast ports. The statement of the trade of the United States is as follows:

Country.	Imports into United States.		Exports from United States.	
	1906.	1907.	1906.	1907.
Bolivia			$242,000	$1,502,000
Ecuador	$3,282,000	$2,835,000	1,835,000	1,884,000
Peru	2,933,000	7,098,000	5,193,000	6,876,000
Chile	17,945,000	9,392,000	9,152,000	11,440,000
Total	24,252,000	27,878,000	16,422,000	21,702,000

The lack of imports from Bolivia into the United States shown by the table is not entirely correct. The bulk of the tin concentrates and other minerals, which form Bolivia's chief export product, go to Europe, it is true, but some rubber and other agricultural products are shipped to the United States, as well as silver ores. Since the shipments are made through the ports of Chile and Peru the exports are credited to those countries. Similarly, the exports from the United States are not all exhibited, since some of them are also credited to the Peruvian and Chilean ports. Of course, in the total of the west-coast commerce they are not lost. The heavy increase of exports to Bolivia consists mainly of iron and steel products—material for the new railway system—and also mining machinery.

The increase of $4,000,000 in Peruvian exports to the United States is due to the development of the copper mines by American capital. Until 1907 the ore was not mined in large quantities because the Cerro de Pasco Company was engaged in building a large smelter. The smelter began operations in the spring of 1907, and its shipments of

copper bars constituted the bulk of the 10,000 tons of copper exports credited to Peru for that year. Since this smelter is now in full operation and another large one at Rio Blanco, also controlled by American capitalists, has begun operations, the copper shipments from Peru will not only be permanent, but will be larger.

The reciprocal market, as it relates to the trade of the United States and as it may afford suggestions for wider sales, is exhibited in the statistical summary of the commerce by articles and countries. According to the figures of the Bureau of Statistics of the Department of Commerce and Labor for the fiscal year 1907, the latest for which full returns are available, the trade was as follows:

UNITED STATES IMPORTS AND EXPORTS OF MERCHANDISE, FISCAL YEAR 1907.

BOLIVIA.

Articles.	Quantity.	Value.
EXPORTS.		
Chemicals, drugs, dyes, and medicines		$12,449
Clocks and watches, and parts of		1,744
Cotton, manufactures of		97,006
Gunpowder and other explosives		9,929
Iron and steel, and manufactures of [a]		564,353
Tobacco, manufactures of		109
All other articles		255,697
Total		941,287

CHILE.

Articles.	Quantity.	Value.
IMPORTS.		
Articles, American, returned		$49,428
Chemicals, drugs, and dyes:		
Soda, nitrate of ... tons	332,079	13,595,458
All other		1,100,047
Copper, and manufactures of:		
Ore and regulus ... tons	14,733	970,477
Pigs, bars, ingots, etc ... pounds	9,938,603	2,184,587
Cotton, unmanufactured	10,124	1,945
Fertilizers		
Fruits and nuts:		
Walnuts ... pounds	587,663	32,138
All other		
Furs and fur skins, undressed		294,248
Hides and skins, all other ... pounds	36,423	6,806
Honey ... gallons		
Lead, in ore and base bullion ... pounds		
Manganese ore, and oxide of ... tons		
Wool, unmanufactured ... pounds	169,408	32,452
All other articles		19,443
Total		18,287,029
EXPORTS.		
Agricultural implements		417,441
Blacking		12,229
Books, maps, etc., and other printed matter		232,300
Breadstuffs:		
Wheat ... bushels	101,387	74,053
Wheat flour ... barrels	88,759	280,102
All other		98,570
Cars and other vehicles, and parts of:		
Cycles, and parts of		5,174
All other		271,458
Chemicals, drugs, etc.:		
Medicines, patent or proprietary		140,286
All other		109,841

[a] The export of railway material began in this period. Its increase is shown in the statistics for the calendar year.

UNITED STATES IMPORTS AND EXPORTS OF MERCHANDISE, ETC.—Continued.

CHILE—Continued.

Articles.		Quantity.	Value.
EXPORTS—continued.			
Clocks and watches, and parts of			$52,515
Coal	tons	40,241	113,738
Copper, manufactures of			23,934
Cotton, manufactures of:			
Cloths—			
Colored	yards	2,130,529	150,727
Uncolored	do	10,661,260	800,115
All other			38,217
Fibers, vegetable, and textile grasses, manufactures of			38,555
Fish:			
Salmon, canned	pounds	4,168,876	286,229
All other			27,067
Fruits and nuts			9,980
Glass and glassware			25,714
Grease, grease scraps, etc			62,533
Gunpowder and other explosives			59,160
India rubber, manufactures of			50,192
Instruments and apparatus for scientific purposes, etc			237,521
Iron and steel, manufactures of:			
Locks, hinges, and other builders' hardware			115,353
Wire	pounds	10,257,167	214,890
Machinery, machines, and parts of—			
Sewing machines, and parts of			128,609
Steam engines, and parts of			210,051
Typewriting machines, and parts of			102,979
All other			785,558
Nails and spikes	pounds	8,888,400	197,747
Pipes and fittings		977,168	36,020
All other manufactures of			639,679
Jewelry, and manufactures of gold and silver			11,080
Lamps, chandeliers, etc			32,829
Lead, manufactures of			14,188
Leather, and manufactures of:			
Leather			124,483
Manufactures of			52,314
Marble and stone, and manufactures of			4,613
Meat and dairy products:			
Lard	pounds	1,787,168	164,717
All other			130,711
Naval stores:			
Rosin	barrels	12,105	52,974
Turpentine, spirits of	gallons	168,127	115,007
Oils:			
Animal—Lard	do	19,580	11,782
Mineral—			
Illuminating	do	5,842,470	657,632
All other	do	1,227,892	234,214
Vegetable—			
Cotton seed	do	220,994	121,030
All other			66,588
Paper, and manufactures of:			
Printing paper	pounds	6,179,156	164,371
All other			80,952
Perfumery and cosmetics			9,161
Plated ware			41,513
Soap			59,985
Stationery			10,509
Tobacco, and manufactures of			12,839
Vegetables			10,516
Wood, manufactures of:			
Lumber—			
Boards, deals, and planks	M feet	77,210	1,232,697
Other lumber and timber			244,029
All other			189,938
All other articles			296,448
Total			10,195,657

PERU.

IMPORTS.			
Articles, American, returned			$21,619
Chemicals, drugs, and dyes:			
Soda, nitrate of	tons	9,977	444,848
All other			179,043
Cocoa, or cacao, crude, and shells of	pounds		

United States Imports and Exports of Merchandise, etc.—Continued.

PERU—Continued.

Articles.		Quantity.	Value.
IMPORTS—continued.			
Coffee	pounds	269	$39
Copper, and manufactures of:			
Ore	tons	3,500	35,845
Pigs, bars, ingots, etc	pounds	7,635,932	1,836,466
Cotton, unmanufactured	do	4,088,669	614,535
Fertilizers—Guano	tons	15,475	179,126
Hats, bonnets, and hoods, composed of straw, chip, grass, palm leaf, willow, osier, or rattan			113,325
Hides and skins, other than fur skins:			
Goatskins	pounds	826,196	250,533
Hides of cattle	do	9,267	1,569
All other	do	43,935	8,234
India rubber, crude	do	165,346	147,816
Lead, in ore and base bullion	do	264,793	12,967
Sugar, not above No. 16 Dutch standard in color	do	35,200,180	681,202
Wool, unmanufactured	do	1,365,843	423,858
All other articles			7,177
Total imports of merchandise			4,958,202
EXPORTS.			
Agricultural implements			44,484
Books, maps, engravings, etchings, etc			33,179
Breadstuffs:			
Wheat flour	barrels	91,512	322,849
All other			166,498
Brooms and brushes			5,592
Candles	pounds	160	15
Cars, carriages, other vehicles, and parts of:			
Cycles and parts of			1,310
All other			290,665
Chemicals, drugs, dyes, and medicines:			
Medicines, patent or proprietary			91,367
All other			70,166
Clocks and watches, and parts of			10,113
Copper, and manufactures of			29,893
Cotton, manufactures of:			
Cloths—			
Colored	yards	803,165	58,581
Uncolored	do	870,806	61,778
All other			35,433
Fibers, vegetable, and textile grasses, manufactures of			93,323
Fish:			
Salmon, canned	pounds	551,160	40,431
Shellfish			19,088
All other			14,531
Fruits and nuts			14,202
Glass and glassware			17,542
Grease, grease scraps, and all soap stock			12,899
Gunpowder and other explosives			109,961
India rubber, manufactures of			20,909
Instruments, etc., for scientific purposes			262,950
Iron and steel, and manufactures of:			
Structural iron and steel	tons	794	45,495
Builders' hardware, saws, and tools			155,289
Machinery, machines, and parts of—			
Electrical machinery			91,217
Sewing machines, and parts of			93,074
All other			959,245
Pipes and fittings	pounds	2,010,950	61,727
All other iron and steel			623,304
Jewelry, and manufactures of gold and silver			7,275
Lamps, chandeliers, etc			14,526
Leather, and manufactures of			114,042
Meat and dairy products:			
Tallow	pounds	495,788	27,696
Lard	do	2,428,049	229,309
All other			94,532
Naval stores:			
Rosin, tar, pitch, etc	barrels	6,128	26,798
Turpentine, spirits of	gallons	45,472	31,588
Oils, mineral:			
Illuminating	do	672,430	89,984
Lubricating	do	197,000	44,327
Paints, pigments, and colors			17,826
Paper, and manufactures of:			
Printing paper	pounds	801,998	16,877
All other			53,907

UNITED STATES IMPORTS AND EXPORTS OF MERCHANDISE, ETC.—Continued.

PERU—Continued.

Articles.		Quantity.	Value.
EXPORTS—continued.			
Paraffin and paraffin wax	pounds	523,976	$33,643
Perfumery and cosmetics			43,487
Plated ware			9,427
Soap			46,416
Stationery: Pens, pencils, mucilage, etc			2,874
Vegetables			17,984
Wood, and manufactures of:			
Timber			90,856
Lumber—			
Boards, deals, and planks	M feet	34,041	551,207
Shooks			36,501
All other			213,732
Furniture			62,252
All other manufactures of			29,618
All other articles			311,949
Total			6,075,739

ECUADOR.

IMPORTS.			
Articles, American returned			$3,088
Chemicals, drugs, and dyes			170
Cocoa, or cacao, crude, and shells of	pounds	8,280,950	1,155,566
Coffee	do	1,488,283	123,538
Cotton, unmanufactured			
Furs and fur skins, undressed			
Hats, bonnets, and hoods			285,552
Hides and skins, other than fur skins:			
Goatskins	pounds	25,854	8,299
Hides of cattle	do	2,298,253	385,332
All other	do	70,675	8,474
India rubber, crude	do	941,274	652,242
Ivory, vegetable	do	11,588,684	388,409
All other articles			98,883
Total			3,059,573
EXPORTS.			
Agricultural implements			5,560
Books, maps, engravings, etchings, etc			4,081
Breadstuffs:			
Wheat flour	barrels	76,622	293,594
All other			11,705
Brooms and brushes			4,873
Candles	pounds	19,048	2,019
Cars, carriages, other vehicles, and parts of:			
Cycles, and parts of			1,209
All other, and parts of			10,487
Chemicals, drugs, dyes, and medicines			84,674
Cotton, manufactures of:			
Cloths	yards	2,087,772	114,970
All other			20,293
Fibers, vegetable, and textile grasses, manufactures of			44,937
Fish			23,516
Gunpowder and other explosives			8,248
India rubber, manufactures of			7,987
Iron and steel, manufactures of:			
Saws and tools			63,004
Machinery, machines, and parts of:			
Sewing machines, and parts of			36,970
All other			122,030
Wire	pounds	1,538,340	38,119
Pipes and fittings	do	225,470	5,397
All other			102,295
Lead, and manufactures of			8,152
Leather, and manufactures of			57,849
Meat and dairy products:			
Lard	pounds	2,901,458	309,722
All other			22,337
Naval stores: Turpentine, spirits of	gallons	6,653	4,895
Notions, not elsewhere specified			720
Oils: Mineral:			
Illuminating	gallons	625,976	39,031
All other	do	57,619	15,941

UNITED STATES IMPORTS AND EXPORTS OF MERCHANDISE, ETC.—Continued.

ECUADOR—Continued.

Articles.	Quantity.	Value.
EXPORTS—continued.		
Paper, and manufactures of		$12,555
Perfumery and cosmetics		10,064
Plated ware		3,466
Soap		4,005
Spirits, wines, and malt liquors: Wines		13,286
Stationery: Pens, pencils, mucilage, etc		1,695
Trunks, valises, and traveling bags		1,206
Wood, and manufactures of		21,378
All other articles		143,813
Total		1,726,289

OCEAN TRANSPORTATION ROUTES.

The movement of commodities from the United States is both through the Straits of Magellan and across the Isthmus. Through the Straits of Magellan the distance from New York to Valparaiso is 9,000 miles; Liverpool to Valparaiso, 9,500 miles; Hamburg to Valparaiso, 9,700 miles. Consequently, there is not much advantage for the Atlantic coast over Europe in the traffic through the Straits or around Cape Horn in the matter of distance, and such advantage as does exist in this respect is more than overcome by the far more numerous shipping lines from Europe. It may therefore be said that for the lower coast there is an equality of international commerce as affects transportation routes with reference to New York, Liverpool, and Hamburg.

By Panama the advantage of distance is with the United States, since from New York to Valparaiso is approximately 5,000 miles, including way calls, and to Callao 3,600 miles. Some of the vessels that ply through the Straits of Magellan make their northern terminus at Guayaquil, while the vessels from Panama have Valparaiso as their southern terminus, connecting at this port with the European and the Chilean coast lines.

EUROPEAN STEAMSHIP SERVICE.

Some of the steamship lines from Europe touch at Rio de Janeiro and Montevideo and then take their course through the Straits. The Kosmos is the leading German line. It traverses the entire Pacific coast as far north as British Columbia. The Roland Line, of Bremen, has a less extended itinerary. The Lamport & Holt Line, from Glasgow and English ports, and the Gulf Line, which is also English, do not usually extend their voyages north of Guayaquil. The Pacific Steam Navigation Company of Liverpool connects at Valparaiso with its West Coast Line, but does not carry Atlantic freight farther north than the Peruvian ports. In addition to these regular lines there are

many tramp and chartered steamers which make the west coast from the English and the German ports.

REGULAR LINES FROM NEW YORK.

The regular lines from New York through the Straits are the West Coast Line and the Merchants Line, whose itineraries extend as far north as Guayaquil. In the spring of the present year the Barber Line, which has maintained a service to Buenos Aires and other east coast ports, established a line for the west coast. The steamers are under the British flag, as are also those of the other companies. The first of the Barber fleet arrived at Callao in March with a cargo of coal from Baltimore and railway material. All these lines schedule sailings at intervals of four to six weeks, according to the cargoes that offer. Some of them call at European ports on their return voyage, not getting sufficient cargo on the west coast for the United States.

The steamship service to Colon from the Atlantic ports is fairly satisfactory. From New York there are sailings every five days by the vessels of the Panama Railroad Steamship Company, which are controlled by the Isthmian Canal Commission. The Hamburg American Company and the Royal Mail also maintain a regular service.

FROM NEW ORLEANS AND OTHER GULF PORTS.

The Gulf ports have direct communication, and since New Orleans and Mobile are 600 miles nearer Colon than is New York, shippers of the Mississippi Valley are beginning to take advantage of this fact, and many shipments, particularly of packing-house products, are now made for the west coast by this route. The United Fruit Company, beginning in August, will put on three large new vessels for both passenger and freight service, with the time between New Orleans and Colon four and a half days. The new steamers are of 5,000 tons and have accommodations for 125 first-class passengers. The steamers will handle freight from New Orleans to Colon, Panama, and points beyond on both the north and the south Pacific coast.

The United Fruit Company in maintaining this service issues through bills of lading in connection with the Panama Railroad and steamship lines so as to enable merchants and manufacturers doing business in the United States to make shipments through the port of New Orleans without inconvenience. The new vessels are equipped for handling return cargoes of bananas, and refrigeration is provided for vegetables and other perishable goods shipped from the Southern States to the Isthmus. The steamers sail from New Orleans Saturdays at noon direct to Colon, reaching there the following Thursday morning. On the return voyage Colon is left Tuesday afternoon and

a stop made at Port Limon, Costa Rica, to load bananas. New Orleans is reached Monday morning.

The Leyland Line also maintains a service from New Orleans by way of Jamaica, while the Hamburg American and the Prince Line dispatch occasional vessels from the same port. The Harrison Line itinerary is via Belize. From Mobile the United Fruit Company dispatches a weekly steamer. From Galveston to Colon there are occasional sailings of tramp steamers.

The New Orleans route is likely to grow in favor with the shipping facilities increased as they now are, especially since this section is in close contact with Latin America and understands Latin-American methods and wants. Many of the west-coast merchants now take this route in coming north and make their initial purchases in New Orleans.

PANAMA AS A STRATEGIC ROUTE.

For increased business on the part of the United States the Panama route is the strategic one. The proportion of traffic via Panama is somewhat variable, but except in the case of heavy machinery, which will follow the Straits until the canal is opened, the tendency is more and more to utilize this route, since the railway service has been improved and cargoes are better handled at Colon and Panama than formerly. The cheaper insurance helps to offset the extra expenses of transshipment.

In 1907 goods from the United States for the west coast to the value of $7,000,000 were shipped across the Isthmus. The ratio is a diminishing one progressively toward the south till Valparaiso is reached. Approximately 5 or 6 per cent of its imports are via Panama. Antofagasta has perhaps 10 per cent, Callao 50 per cent, and Guayaquil 75 per cent. Peruvian agricultural exports—cotton, sugar, and wool—are now coming up this route, while copper also follows it.

INSUFFICIENT WEST COAST FACILITIES.

The traffic has great possibilities in both directions, but the one conspicuous fact about transportation on the west coast has been its inefficiency and the failure of the existing lines properly to provide for the growing commerce. This applies especially to passenger travel and to the mails. The transportation is controlled by two companies, the Pacific Steam Navigation and the Compania Sud Americana de Vapores. The former is an English company and the latter is known as the Chilean line and enjoys a small subsidy from the Chilean Government. So far as the traveling and shipping public are concerned the companies are one. Occasional rivalry between different steamers does not alter this condition. The earnings are pooled and the service is in every way one of combined companies who maintain a monopoly.

The companies have a working arrangement under which a steamer leaves Panama alternately on Thursdays or Fridays and one arrives from Valparaiso on Tuesdays or Wednesdays. This arrangement until recently was observed on paper only. At some periods there would be reasonable regularity and then would follow a time of absolute demoralization. New York agents of the companies state that the steamers now leave Panama regularly on scheduled dates, their orders being not to wait for freight, whether it is ready in sufficient quantity to provide a full cargo or not.

EXCUSES GIVEN FOR INEFFICIENT SERVICE.

An example of the present slow service may be had by comparing the mails between New York and Bombay and New York and Callao, respectively. The distance from New York to Callao is 3,600 miles; to Bombay, 8,500 miles. By timing the departure of the steamers a letter may be transmitted to Bombay and an answer returned in the same period that ordinarily is required to transmit one to Callao and receive a reply. One reason usually given for the slow and irregular service is the delays which are caused by quarantines. It is true that quarantine delays are sometimes vexatious, but the conditions have been improving, while the steamship service has been getting worse. The real trouble seems to be in the lack of competition. The Pacific Steam Navigation and the Chilean lines not only are formed into a trust, but they also have an understanding or agreement by which the Kosmos Line does not touch at Panama and the Pacific Mail runs no steamers south of Panama in consideration of the former not running their steamers north of Panama.

The nature of the coast business is given as another excuse for the slowness of the service, the time from Panama to Callao being twelve to fourteen days and from Callao to Valparaiso a similar period. Ordinarily through passengers and the mails are fortunate if Valparaiso is reached within twenty-five days after leaving Panama or vice versa. Instead of touching at only a few leading ports, such as Guayaquil, Callao, Mollendo, Iquique, and Antofagasta, all the steamers put in at numerous minor ports. Both companies also maintain an auxiliary coasting service for the minor ports. Where competition of any sort has been secured a surprising improvement has been made. An Italian-Peruvian company established an independent service along the Peruvian coast and at once better service was provided by the English and the Chilean companies, with lowered passenger and freight rates.

PERUVIAN GOVERNMENT'S FAST STEAMSHIP PROJECT.

The unsatisfactory shipping service and the consequent loss to commerce caused the Peruvian Government to lend its support to the

project for an independent line between Callao and Panama. A company was formed with a capital of £350,000 ($1,703,275), the stock consisting of 300,000 shares. The Government took 30,000 shares and provided an annual subsidy of £30,000 ($145,995) for fifteen years as interest and amortization. The company was also authorized to issue bonds to the amount of £300,000 ($1,459,950), which were to be floated at not less than 92½.

The basis of the service is to be a large steel floating dock and two large steamers capable of steaming 18 knots per hour, with four auxiliary steamers. This plan assumed that an itinerary could be established for a four-day service between Panama and Callao, with a stop at Paita or Tumbez to receive and discharge Guayaquil passengers and mail. Vessels of lesser speed and therefore of less expense would answer the purpose, five days or even six not being too long, provided the service were regular, so that postal connections could be made and the passenger and freight facilities could be depended on. The chief point is to secure regularity and reasonable rapidity. With a five-day schedule between New York and Colon and a five-day service between Panama and Callao the mails will be greatly benefited, both by cutting the time in half and by the regularity that will be insured.

The Peruvian company ordered the steel floating dock at a cost of £90,000 ($437,985), and it is to be delivered at Callao in October. It will serve to relieve the congestion of traffic there, though until the new steamers are put on the line its utility is limited. The order for the two new steamers was given to English shipbuilders in April, but it had been anticipated and the work was under way. The vessels are to be 18-knot turbine steamers of the Parsons type, of a gross registered tonnage of 3,500 and with accommodations for 350 passengers. The delivery of the first one is promised at Callao in February, 1909. With the putting of this vessel into commission the Peruvian Government will have made the most important step that has been taken in years for improving the west-coast trade relations, and the United States will be the chief gainer.

CHILEAN GOVERNMENT'S PROPOSED SUBSIDY.

One result of this Peruvian enterprise has been the quickening of other governments and the partial awakening of the English and the Chilean lines from their somnolence. Once a fast line between Panama and Callao is established, another fast line will be essential between Callao and Valparaiso, with one or two intervening stops, or even a direct service might be maintained between Valparaiso and Panama.

The President of Chile in January of the present year caused a bill to be introduced in Congress authorizing the Executive to enter into

a contract with the navigation companies for the establishment of a steamship line between Valparaiso and Panama which should make the trip from one port to the other in not to exceed eight days. The Government was to pay the company accepting the conditions an annual subsidy of $100,000 and the contract was to last for five years. The Chilean Congress has not yet legislated on this proposition, but the fact that it came from the Executive gives it standing as a basis for prospective legislation.

The Pacific Steam Navigation and the Chilean companies have also sought to meet the possible competition of the Peruvian line by adapting their facilities to the terms of the proposed Government subvention. They have proposed to run weekly vessels from Valparaiso to Panama on a twelve-day schedule, making stops at Valparaiso, Coquimbo, Antofagasta, Iquique, Mollendo, Callao, Paita, and Panama. Auxiliary steamers will distribute the freight from these ports of call, while the present service between Panama and Guayaquil, which is distinct from the other west-coast service, will be enlarged.

Should the promise of a twelve-day service between Valparaiso and Panama be carried out, it will be possible to arrange the Colon connection for New York so that the whole journey can be made in seventeen days and mails and freight handled with much more expedition than at present. The west-coast traffic is now so important and its possibilities so great that the existing inadequate facilities for handling it can not be permitted to continue indefinitely.

ADVANTAGES OF THE PACIFIC PORTS.

For the Pacific ports of the United States there are many natural advantages in the means for avoiding transshipping. Besides the sailing vessels and the Kosmos steamers, a service is maintained between San Francisco and Callao by the North Pacific Line of W. R. Grace & Co. and the English and German tramp steamers. The business of California and the adjoining States with South American countries is in staple products, and as the demand grows in these countries it will expand. Lumber and flour are the leading shipments, but there are also agricultural implements, fruits, petroleum, and beverages. The aggregate value is large.

One very striking feature of west-coast traffic is the number of sailing vessels which engage in it in competition with the steamers. This section might be said to be the last refuge of the sailing ships. The nature of the cargoes gives them their opportunity. Time is not usually an element in the importation of coal, and it is brought in the sailing schooners from Australia and from Wales. Similarly time does not enter into the nitrate shipments from Chile, and the majority of these bulky cargoes are exported in the sailing vessels,

the ships often serving as floating warehouses, which can be diverted from their regular course or delayed, according to the market. The coal and nitrate shipments also afford return cargoes in many instances. The heavy importations of lumber on the west coast furnish the sailing vessels with a large traffic, and they are able to handle this class of business most satisfactorily. The bulk of the shipments from California and Oregon are brought down the coast in schooners or in larger sailing vessels.

The discussion of rates in connection with transportation and vessel lines is omitted here, because the very complete exposition of the whole subject in the report of Special Commissioner Joseph L. Bristow (Senate Document No. 429, Fifty-ninth Congress) and the supplemental information of Special Agent Lincoln Hutchinson regarding shipping facilities in his report on west-coast trade conditions render further explanation unnecessary. The European shipper, by various devices of the steamship companies, still seems to get cheaper rates for most commodities than do the shippers in the United States.

STEAMSHIP LINES TO CHINA AND JAPAN.

It should be noted that there are Asiatic steamers to and from the west coast. The Asiatic trade excites interest in view of its possible development along competitive lines with the United States and Europe. There is a large Chinese colony in Peru, and the Chinese merchants, in conjunction with Hongkong merchants, have for years operated a steamship service between Callao and Hongkong and the other Chinese ports.

In 1906 the Japanese Government subsidized a new company known as the Orient Line between Yokohama and Callao and Iquique. This has done a fairly good business. Its cargoes have been chiefly of rice, with some railway ties, coal, and a little merchandise, including silks and teas. The return cargoes have been mostly Peruvian sugar and Chilean nitrates, with a little wool and cotton. The sailings have been about one vessel every six weeks. The shortage of rice on the west coast furnished the most profitable basis of this traffic, but in the spring of the present year the dealers along the coast found themselves overstocked, while the Peruvian crop indications were that it would be almost sufficient to supply the home demand. So for at least two years the rice cargoes are not likely to be carried by the Japanese steamers. Japanese coal is of a poor quality and only in exceptional cases can it compete with the coal from Cardiff and Australia.

Looking several years ahead some persons foresee the time when Japan will be shipping cotton piece goods to the west coast in competition with Manchester, and machinery in competition with the

United States, but this can not be said to be an immediate prospect. As to the return cargo the Peruvian sugar exportations are not likely to exceed 5,000 tons annually. The Japanese soil needs fertilizers and there is more certainty of the nitrates from Chile. Large quantities of jute bagging are imported by Chile from Calcutta, but this cargo is not available for the Japanese ships. The experiment of the subsidized Japanese line can not therefore yet be said to indicate a successful outcome. Both it and the Chinese line derive a good deal of their revenue from immigrants of the coolie class. All the west-coast Governments are now restricting and discouraging Chinese immigration. They can not on account of their treaties take so radical a course with Japan, and the Japanese immigration companies are supplying a few thousand coolies annually. This, however, can not be looked upon as a permanent source of revenue for the steamship companies.

UNITED STATES SANITARY AUTHORITY AT PANAMA.

Details regarding a west-coast itinerary for commercial travelers and others are set forth in the appendix, and in connection with the subject of transportation only one additional point that relates to commerce is here indicated. While quarantine regulations are a necessary evil, their ill effects in interfering with trade are being reduced to a minimum. This is because of the control now exercised by the United States sanitary authorities at Panama. Instead of conflicting and hostile regulations a general plan is followed.

The United States, besides being the sanitary power at Panama, has Marine-Hospital physicians stationed at Guayaquil and Callao. They are there by the courtesy of the Governments of Ecuador and Peru, but these Governments have got beyond the point of merely receiving them courteously. The Governments now cooperate most heartily with the measures suggested by the representatives of the Marine-Hospital Service, and the authorities of Panama govern their regulations of the vessels from down the coast by the suggestions received from these physicians. At Guayaquil Dr. B. J. Lloyd is not only the United States representative, but is chairman of the commission which was created by the Ecuador Government to stamp out bubonic plague and to make Guayaquil a sanitary port. Though all this can not be done in a day or a year, it can in time be accomplished, and the measures now in force are already proving beneficial to commerce.

At Callao the Peruvian Government has voluntarily placed certain authority in the hands of Doctor Wightman, the Marine-Hospital representative, and has availed itself of the experience of the United States medical service.

METHOD OF ENFORCING QUARANTINE REGULATIONS.

Vessels leaving Panama are dispatched by the sanitary authorities, and the success which has been obtained by the American officials in freeing that port from yellow fever is a great advantage to the captains and the agents, since it relieves apprehension and avoids vexatious delays. Vessels coming up the coast are inspected at Callao by the Marine-Hospital physician and their health condition is certified. The process is repeated at Guayaquil. These up-coast vessels are not allowed to go to the wharves or docks where such harbor facilities exist for loading or taking on passengers. Instead they are served by lighters. By avoiding communication with the shore the danger of contracting bubonic and other epidemic diseases is materially lessened. In consequence it is rarely now that a vessel on reaching Panama is put in quarantine and its cargo delayed in unloading. Passengers from Guayaquil go to the quarantine station for two days if they have not certificates of yellow fever immunity, and the same precaution is taken in regard to bubonic. Excellent quarters are provided at the quarantine station, and the inconvenience to travelers is as slight as it can be made with due regard to safety. There is seldom interference with cargoes.

The authority possessed by the sanitary officials is exercised discriminatingly, yet unsparingly where necessary, and the result has been to secure a much better observance of health regulations by the commanders of the vessels. After a steamship has been once ordered into quarantine for being in insanitary condition, not only the captain of that particular steamship but the commanding officers of all the vessels take notice, and it is not often that the lesson has to be repeated.

INSPECTION BY CHILE AND PERU.

Vessels coming through the Straits of Magellan are subject to inspection by the Chilean authorities, and also by the Peruvian authorities, if they proceed farther north. Peru has a quarantine station at Ilo, its most southerly port, where all vessels are disinfected and fumigated. In consequence of these improvements in quarantine and in sanitary supervision the danger to which the west coast is inevitably exposed is decreased and many of the losses heretofore sustained by commerce are avoided. Not everything has yet been done that should be done, but the spirit of cooperation is spreading and the measures of the various Governments are based on a common system, which was not the case formerly. Further improvements may be made in the future when all the countries become parties to the general sanitary treaty of Washington, which has been recommended by the different Pan-American conferences and by the sanitary conventions that have grown out of those conferences.

TRADE EXTENSION WITH UNITED STATES.

The general situation of the west-coast countries, their resources and industries, their actual and prospective development, the bases of their purchasing power for foreign goods, and their transportation facilities and fiscal systems having been sketched, specific suggestions as to the means of building up commerce by American manufacturers may now be offered. These trade hints are the outcome of suggestions which have been made to the author by men engaged in the importing business and who are familiar with the requirements of the market. A good deal of primary schooling is yet necessary in Spanish-American trade methods for manufacturers and exporters in the United States.

SPANISH LANGUAGE SHOULD BE EMPLOYED.

The spread of English facilitates commercial intercourse with Spanish-American countries, but in no possible view does it do away with the need for knowing Spanish. Business correspondence with importing firms in most cases may be carried on in English, because some of the members themselves, where they are not American, English, or German, nevertheless speak and write English, or have clerks who do so. But this does not touch the main point, which is to reach the buyer or the person who is to be induced to become a buyer. The retail dealer, as a rule, only knows Spanish, and this is true also of his customers, and to make any article known its merits should be set forth in the language of the retailer and of his patrons.

While correspondence in English with importing firms may serve, there are many large houses, especially at points away from the seacoast, with whom the prospect of securing business would be much better if the forms of Spanish correspondence were followed. Catalogues in English may be studied out by them, but Spanish is infinitely preferable, and general descriptive matter is worthless unless it is in the language of the country. Many well-known proprietary articles and food preparations of English and French make, in the long course of years, have established themselves so thoroughly that Spanish labels are not required, yet for the majority of goods they are desirable, and this is especially the case with new articles seeking a market. The Germans almost invariably have their goods labeled in Spanish, even where they are as well known as the English and French articles.

TRADE-MARKS AND ADVERTISING.

In the introduction of a new article the very first step should be to register the trade-mark. The trade-mark regulations of the different countries are not illiberal, but they are not framed to make business easier for negligent manufacturers abroad. So it happens that a good many mineral waters, beverages, and similar products which

are universally known can not get into South America under their own trade-mark name because some native has appropriated and registered it for an inferior local product.

Advertising is as essential in Spanish America as in the United States, but it has not yet been reduced to a science. The newspapers are by far the best medium. Their circulation is small, but they have the advantage of being thoroughly read. Whether the paper is published in the morning or in the afternoon, no one is too busy to read it from the first column on the first page to the last column of the last page, and the advertisements are rarely overlooked. Display advertising is still the chief feature, the small ads not being used except for a limited number of purposes. Any good selling article of merchandise takes a display. Newspaper advertising rates are relatively cheap, especially under contract for a given time, and the preference is for yearly contracts. Usually publishers can be depended on for a strict adherence to their contracts. Local merchants recognize the value of this medium, but it is desirable that they should receive encouragement from the exporters whose goods are handled.

There are no general advertising agencies through whom business can be done with a group of newspapers, but in all the larger cities the facts as to circulation, the classes of readers, etc., are easily ascertained. Some large merchants follow the plan of American dealers and publish special papers of their own in which reading matter is varied with the advertising of the articles of merchandise that are handled. These publications are circulated without subscription charge. At Trujillo, in northern Peru, there is a newspaper of this class, and there is another one at Cuzco, in southern Peru, which is the distributing center for a population of 250,000. Either of these journals would compare favorably with those of a similar kind in the United States. In all the large cities there are illustrated weeklies and monthlies in which colored "comics" and cartoons are popular advertising features.

LITHOGRAPHS, BILLBOARDS, AND CATALOGUES.

After the newspapers the most successful advertising is by means of lithographs. These should be highly colored, even gaudy. They are quite extensively employed, and in most of the countries form an item in the customs schedule, being dutiable. The duty, however, is not heavy enough to discourage their use. For agricultural implements, lithographs are especially valuable. They require to be durable, and generally should be prepared so that they may be hung up, instead of being merely tacked to the wall.

There is some advertising by means of billboards and posters in most of the west-coast cities, but its utility is limited. Usually it is subject to rather stringent municipal regulations and the privilege is

farmed out. In Lima the concession is held by an American. Street-car advertising does not appear to meet with much favor, though it has some utility. Advertising by means of variable electric signs, etc., has not been much exploited, though its novelty appeals to the Spanish American. Little attention is paid to window displays as a means of advertising goods.

The value of catalogues and circulars as advertising mediums is doubtful, especially when sent out miscellaneously. Some of the consuls make an effort to classify and display the catalogues and trade papers which reach them, but it is impossible for them to handle all the printed circulars.

Where this kind of matter is sent to addresses at random, procured from the commercial directories and similar sources, in nine cases out of ten it is a dead loss. Where it is not held in the post-office for insufficient postage or dumped in the scrap heap on account of torn wrappers, it is often left unopened. Bushels of it may be seen in some of the big importing houses. Usually a clerk looks at the wrapper with the sender's address, and if the matter is from some firm which is known it is opened, but otherwise no heed is given it. It must also be kept in mind that in the South American countries mail matter is registered much more generally than in the United States. The safe rule would be for exporting or manufacturing firms first to secure attention by means of a letter, and then to register the printed circulars they send. While this may seem expensive it is an actual saving, because it insures the matter being received and opened. Letters usually do not need to be registered.

A POINTED EXAMPLE.

The value of carefully prepared descriptive matter in Spanish was illustrated to the writer at one of the interior points, where a large importing firm was going to make a trial importation of disk plows. It had the catalogues and the descriptions from a number of manufacturers, but all except one of these were in English. The member of the firm who was handling the matter had lived in the United States and read English very well, but when it came to understanding the description of the way to handle disk plows he grasped it much better from the Spanish booklet. Moreover, his assistants, who would have the actual placing of the order, and would have to give instructions to the overseer of the estate where the plows were to be used, did not read English. So the order was placed with the firm which in organizing its export business had not neglected the essential element of Spanish circulars for Spanish-speaking countries.

The best advertisement of any article is of course the thing itself, and some one to tell about the thing, and how it can be used; or, if

machinery, how it should be worked. That means the sample and the commercial traveler. In an interval of five years between visits to the west coast it has been a great satisfaction to note the advance made by American manufacturers in providing for this market by employing competent drummers. In several instances which came to notice the principals themselves were making trips with a view to learning the general requirements and then to sending out their own men. This was the best possible method, but since it is not always practicable, the next thing is to provide intelligent traveling agents. It is no reflection on the American drummer to repeat that the one who is successful at home is not necessarily the best man to send abroad. The essential requirement is that of a traveled gentleman who knows the language, and who either intuitively or through experience can adapt himself to local customs.

REQUIREMENTS FOR COMMERCIAL TRAVELERS.

The club is an important element of intercourse in commercial affairs. All the west-coast cities have societies to which visitors may be admitted with proper introduction, and commercial travelers should provide themselves with letters which will insure them the privileges of the clubs. A further requirement in business intercourse is not to be in a hurry. One large importer in the interior of Peru was known to change an order from Berlin to New York because the American drummer who approached him not only spoke Spanish excellently, but calmly settled down in the city and made his campaign in a leisurely manner. It only took a fortnight in this instance, but the drummer stated that he was prepared to stay three months, for he knew the value of the business that he wanted. It has lasted for years and is now one of his most valuable assets.

An evolution of the drummer which is now going on is that of the manufacturers' resident agent. Several of these agents have established themselves at a number of cities, and all are doing well; but every one of them had had long experience as a traveling man in South America and knew thoroughly the requirements and the peculiarities of the trade. These manufacturers' agents aim to secure a noncompetitive but fairly extensive line of goods which will not be too large for them to push individually. Some do their own traveling, while others employ subagents. Though their sales are made on commission, usually they have capital of their own and can meet the conditions of the exporters in regard to cash with orders or time drafts.

In every case these manufacturers' agents are able to give the specific instructions in regard to invoices, packing, etc., which are so essential to foreign trade and which usually are so calmly ignored by

American shippers. Some of them have elaborate printed forms which, when followed, save a great deal of unnecessary correspondence as well as time. Observance of the instructions contained in these forms should be impressed by factories and exporting commission firms in the United States on their shipping departments. The agents who have located themselves in the Spanish-American countries know the weak points in the shipments and their suggestions are made to correct them. For a factory seeking to introduce its goods these agents advise that plenty of time be taken in paving the way—at least a year—before inviting trial orders.

VALUE OF EXPORT AGENCIES.

Some European houses, notably French ones, have export sales agencies on the same principle as the American manufacturers' agents who have established themselves, but much more thoroughly organized and directed from Paris. There are many advantages in this system. It centralizes the business for export at a given point and insures cooperation at reduced expense. A suggestion has been made for the establishment of an American export agency with Panama as the base, and with a warehouse with stock to fill orders and from which samples could be supplied to traveling salesmen. No steps, however, have been taken toward carrying out the idea, which would require the cooperation of manufacturers in a dozen or more different lines. Lima would be another central point for the establishment of a warehouse by a group of manufacturers.

An important point in South American business is that the number of small American manufacturers who are reaching out for it is increasing. For them the first thing to know is the best way in which they can get a foothold for their specialties. South of Ecuador it may be said that the bulk of the import trade is controlled by not more than ten great firms, only one of which is American, and even it has European connections. The majority of the firms are English, though there are several strong German ones. The big houses have large capital and unite commerce, shipping, and development enterprises. In addition to doing a business in importing and exporting general merchandise, they are either joint owners of shipping lines or are agents of the steamship companies, and in that capacity it is not easy to distinguish them from partners.

Some of these houses are engaged in the exploitation of mines, in irrigation enterprises, in sugar and cotton plantations, and in railway building. This mixing of all kinds of business is an outcome of the conditions which obtained more than half a century ago when the shipping companies or firms went into mercantile business in order to build up the commerce for a carrying trade. Once in the mercantile business they put capital into development enterprises because their own money was all that could be procured for these purposes,

and development of resources was necessary in order to develop trade. They have continued along these collateral lines until, with many of the houses, it is difficult to differentiate their interests. The headquarters are generally at Lima and Valparaiso, with branches at all the ports of any importance, and also in Bolivia.

ADVANTAGES AND DISADVANTAGES OF THE SYSTEM.

For the manufacturer seeking west-coast trade this system has advantages and disadvantages. Some of the importing firms will take only exclusive agencies, while others make no discrimination and will handle any goods that are offered them, but without pushing sales. Where an American manufacturer or commission agent establishes relations with one of these big houses the advantage in dealing with an established firm is recognized. The benefit of its prestige and its knowledge of local business requirements is immediately secured. There is also the most decided benefit of dealing with a firm whose credit is unquestioned and of avoiding the losses which are incurred or the risks which have to be taken in dealing with smaller concerns whose business is purely local, and whose credit and capital are both limited.

The disadvantage is that houses having so many lines of goods can not always be relied on to push any particular line. They merely handle goods for which a demand exists and they are not likely to enlarge the market. As shipowners or ship agents they are also likely to give themselves the best of the rates. Moreover, in the cases of firms which have exclusive agencies the new article which is competitive can not secure a foothold through the medium of these established firms, and the manufacturer is compelled to seek other means of introducing it. The combination of shipping, trading, manufacturing, and farming will some day disintegrate, and trade and industry follow more normal lines, but that is not likely to occur soon, though its signs are visible. Manufacturers therefore should inform themselves of the character of these great firms and determine whether to seek the west-coast market through them or through separate agencies.

In the case of machinery there is a greater field for selection, because, while the big importing houses handle machinery, there are also many houses which make a specialty of it and deal very extensively. There are also engineering firms which specialize in the various kinds of machinery. But for general merchandise the choice is rather limited. Some of the large American mining and railway companies are now making their purchases direct through their purchasing agents in the United States.

VARIETY OF GOODS HANDLED.

The variety of goods which may be handled by a single firm is infinite, including dry goods, provisions, and iron and steel products.

One wholesale firm, which does not handle textiles, gave me the following list of goods imported from the United States by them, though their commercial connections are English, for which they were finding a wide market:

Wire nails.	Bolts and nuts.
Barbed wire No. 12.	Tinned meats.
Galvanized staples No. 9.	Axes.
Varnished wire No. 16.	Cane knives.
Galvanized wire No. 20.	Picks and handles for picks.
Turpentine, "Pine Tree."	Lubricating and machine oils.
Salmon.	Preserved meats.
Sisal rope.	Oysters.
Rosin.	Tinned California fruits.
Hams.	Roofing.
Wheelbarrows.	Safes.
Scales.	American whisky.
Plows.	Box shooks.
Chains.	Railway ties.
Shares and land sides for plows.	Sugar clarifiers.
Lard.	Chairs.

EXPANSIVE MARKETS.

It may be said that there is hardly an article for which a market may not be found. New wants are created among the Indians of the Andean plateaus as easily as on Fifth avenue in New York. There is scarcely an out-of-the-way place in which some line of imported goods can not be sold. The drummer for a New York house dealing in laces and embroideries went up to Bolivia among the Indian population and in a short time established a good business, notwithstanding that his line was a comparatively expensive one. The explanation was the Indian woman's love for finery. On Sundays and festival days they appear togged out not only in brilliant colors but in really fine garments. Since there is a large number of holidays the occasions when this finery can be used are frequent, and one outfit does not last an Indian woman her lifetime. When it is considered that there is a population on the Bolivian plateau of 1,000,000, it will be seen that this is a market not to be despised. The very fine high-laced shoes, some of which are imported, and some of which are of native manufacture, and all of which sell from $12 upward, is another illustration of purchasing ability and of wants which are highly civilized. The same love of finery also exists among the Indians of Peru and Ecuador, and they manage to find means to gratify it.

FIELD FOR MANUFACTURERS.

Closer touch should be kept by manufacturers in the United States with the sales agents or others to whom they assign certain territory, in order to see whether these agents are fully responsive to the interest that may be awakened in their products. Many manufacturers take

the necessary steps to make their wares known and create a demand for them, but when letters of inquiry come they merely reply, referring the inquirer to the agent who has control of that territory. Then they put in operation their system of "follow up" letters in order to keep the prospective customer on the hook. Meanwhile no attempt is made to learn whether the agent who has the territory is attending to the inquiries.

A large dealer who saw an opportunity for increasing the sales of woven wire fencing gave an amusing illustration of this carelessness. He had written to the factory stating his wants, and received a reply referring him to the New York agent who controlled sales in that district. He at once wrote to the agent, but received no reply, though letters and literature kept coming from the factory all bearing the earmarks of an enterprising "follow-up" system. The follow-up letters should have been sent to the New York agent; but apparently the factory did not think of this, for the prospective customer never heard from him. Numerous other instances of this apparent lack of cooperation between the factories and their agents in the United States who control foreign territory might be given.

FAULTS TO BE CORRECTED.

American manufacturers in getting over one fault are committing another. So much has been said about dumping surplus stocks and inferior articles that the subject does not call for reiteration. The practice of sending second-rate stock to South America was so prevalent a few years ago that it had become a by-word whenever American trade was spoken of, and it was one of the drawbacks to more extended sales. While this practice has not entirely ceased, there has been such a noteworthy improvement and such a commendable spirit shown to supply good articles, that there is no longer occasion for wholesale censure. But manufacturers in the United States should not go to the other extreme and insist on supplying a better article than is wanted. On general principles it may be true that the best is none too good, but in the case of South America, where customs change slowly and where the best is not always wanted, it should not be supplied.

The Spanish-American merchant knows his customers just as the merchant in the United States knows his patrons. When, therefore, he calls for an article of a good quality but not of a superior quality, he means just what he says. So far as it is profitable he may lead to higher things in the way of the best articles for his customers, but he will not seek to force their preferences nor will he be forced by the foreign manufacturer. He is getting away from the cheap German goods, and that is progress enough for the present.

MIDDLEMEN'S BIG PROFITS.

One practice which it is difficult for American manufacturers to meet is that of middlemen's high profits. In a variety of articles, particularly clothing, household wares, and food stuffs, traveling salesmen see where much larger sales could be made if retail prices were lower. Knowing that the middleman is getting 100 per cent, they urge him to fix a lower price for the consumer with the assurance that increased sales will more than make up the decreased percentage of profit, but the Spanish-American practice always has been small sales and high profits, and the merchant is very stubborn about reversing his position. The middle class is not large, but it is a growing class in all these countries, and very many articles which are suitable for it remain luxuries on account of the extortionate profits of the retailer.

In only a few instances are the manufacturers able to enforce a set price. Some of those whose boots and shoes are sold on commission do it, and in a few other special lines a set price determined by the manufacturer is obtained. For general merchandise products the only remedy I can suggest is a persistent campaign of education on low prices by the manufacturers in their printed matter, in their correspondence, and in the intercourse of their traveling salesmen with buyers.

PACKING AND TRANSPORTATION.

Nothing new can be said about packing, but some old directions, suggestions, warnings, cautions, and remonstrances may be said again briefly. The leading points are very simple. Packing as for domestic orders will not do. Goods require much rehandling. Even where they are sent through the Straits and transshipment avoided they are certain to receive hard treatment before they reach their destination, especially since many of them have to be transported over the mountains.

The west coast is a rough coast. Almost no freight is landed at wharves or docks. Almost all freight has to be lowered from the steamers into lighters and small boats. At almost all landing ports during the greater part of the year smooth waters are unknown. The unloading usually is done in the midst of a heavy surf, and a drop of 8 to 12 feet for packages from the steamer to the lighter is no unusual thing. At the jetties or piers there is equally rough handling with the cranes and other appliances for unloading the lighters where unskilled hand labor is not the sole means. Then there is the reloading on the cars, and for large quantities of goods a subsequent unloading and reloading on mules and other pack animals which carry the freight over steep mountain trails. Whether shipments are via the Isthmus or the Straits, a part of the voyage of the cargo

must be through the Tropics, with their hot, humid atmosphere, and its destructive appetite for poor packing cases.

These simple facts should impress on exporters the importance of strong packing cases. Brittle pine lumber should not be used and cases should be bound with strap iron. At the same time these should be light, since in many instances the customs duties are assessed on gross weight. Machinery parts, of course, should be labeled and duplicates be sent in separate cases, and castings should be carefully secured. All boxes and crates should be numbered, and in addition to the consignee's mark it is well to have the gross weight marked in kilograms, since this facilitates the customs entry.

INSTRUCTIONS AND REGULATIONS.

The instructions issued by the Panama Railroad Steamship Line, and which have been printed by some of the railways in the United States and made obligatory on shippers over their lines, are so pertinent that I quote them:

Complaints have come to us recently so persistently concerning the inadequate packing of goods that we feel compelled to bring the matter to the attention of our patrons.

European manufacturers have learned by experience that adequate packing is an excellent investment, as contents reach destination in good shape, whereas American manufacturers are neglectful in packing for export, to the detriment of merchants, transportation companies, and the manufacturers themselves.

We ask the cooperation of all shippers and consignees in an effort to diminish frail packing, as it is to their benefit as well as to that of the transportation lines to have shipments delivered in good condition.

We shall hereafter refuse packages too frail to hold contents or not in condition to withstand necessary handling during the voyage, as we decline to assume responsibility for the shortcomings of packers.

Boxes or cases weighing four hundred (400) pounds or less must be of material three-fourths (¾) of an inch in thickness or greater; boxes or cases weighing over four hundred (400) pounds must be of material at least one (1) inch in thickness.

All packages to be bound with steel or hickory straps at least one (1) inch wide.

Special attention is called to the fact that ours is a water route with transshipments, and hence better packing is required than if the cargo were to be transported with little or no rehandling.

There is room for improvement on the part of commission agents in ordering goods from the factories. In many instances the factories do not know where the goods are consigned, and if the commission agents notified them and stated the requirements of the packing this would be likely to receive attention.

A SERIOUS EVIL.

For one trouble in west-coast shipments exporters are not responsible. This is the great amount of thievery, especially of small pack-

ages. It is universal, and while it is deplored no remedy has yet been found by the steamship companies, which are the heaviest losers, both because of the losses they have to make good and on account of the controversies with shippers. But while exporters are not to blame for this condition, they can mitigate it and save themselves trouble and loss by following the directions of the importers. The latter, having to contend with the evil, seek to lessen it by providing means of avoiding the knowledge of the contents of the packing cases. For instance, a case of prepared chocolate, if not stolen outright, is apt to lose part of its contents. But if it is shipped in a plain box and is not known to be chocolate, there is less danger.

One of the greatest losses is in shipments of boots and shoes. Some importers insist on measures being taken to disguise the contents of packing cases of this kind because otherwise a certain number of pairs are likely to be purloined, and frequently mates are not taken, so there is a double loss. Until the steamship companies and the companies which control the lighterage devise complete protection the only suggestion that can be made is to repeat the importance of heeding the directions of the importing firms. This, however, should be done in all cases.

PROMPTNESS IN SHIPMENTS.

Prompt shipment is another point which must receive more consideration if the markets are to be enlarged and maintained. The American manufacturers, it sometimes seems, are sinners in this respect from choice as much as from indifference. The number of cases brought to my attention in which importers have been exasperated to the point of canceling orders by the failure to fill them on time have been almost as numerous as the instances of bad packing. In the nature of present transportation facilities the inevitable delays are bad enough. American exporters should not make them worse by giving the home market orders preference over those from abroad. They may be sure that in every instance in which they neglect the foreign order they are losing future trade. English and German exporting houses are so prompt in meeting the requirements of their South American customers that the contrast with the methods of many manufacturers in the United States is a constant argument against buying American goods.

UTILITY OF PARCELS POST.

The utility of the parcels post as a trade getter is not appreciated in the United States. Treaties are in force with Ecuador, Peru, Bolivia, and Chile. Packages up to 11 pounds in weight can be sent at the rate of 20 cents a pound. Many specialties produced in the United States could be introduced and a permanent sale maintained through the medium of mail orders.

The parcels-post business of England and France with the west-coast countries is very large, and the variety of articles carried in this manner is surprising. In Chile, in a recent year, the value of the parcels-post importations was 1,113,000 pesos, or about $350,000. In the other countries it is proportionate. The shipments from England and France are not through any central agency, such as the mail-order houses of the United States, but by independent concerns which forward only their own products. In this respect the mail-order houses of the United States would have a decided advantage. One reason, as I am informed, why they have not heretofore taken it up has been their doubts as to the value of the market, but the experience of European firms should be conclusive on this point.

A more practical objection appears to be the difficulty of getting out catalogues in Spanish on the comprehensive scale which obtains in the United States, since the catalogues themselves are so expensive that a general distribution of them would not be feasible. But a careful study of the average of the wants that obtain in Spanish-American countries which could be supplied through the mails undoubtedly would enable a relatively small Spanish catalogue to be provided. It would be found that many importing houses as well as individual customers would avail themselves of the opportunities offered by these catalogues. The growing number of Americans engaged in mining and railway building who are scattering all through South America, and who have many wants which could be supplied directly from the United States, seems to offer a practical basis for beginning the business.

The customs regulation of the different countries regarding importations through the mails are not burdensome, and in all of them international money orders can be obtained by would-be purchasers. Some mail-order business is now done with Mexico, and the conditions in other Latin-American countries are enough alike to enable the Mexican business to be broadened. In 1907 there were 4,340 packages of merchandise dispatched from the United States to Chile as against 1,710 packages in 1901, thus showing a decided growth. No business was reported with Ecuador, Peru, or Bolivia.

MEANS FOR SECURING LARGER TRADE.

The means at hand for getting a larger share of the growing west-coast business should be known in detail by American manufacturers and exporting agents. There are not only the general facts, such as contained in this report, but a mass of specific information has been gathered for the benefit of special lines of trade. The foreign trade opportunities published in Daily Consular and Trade Reports often indicate the market for a particular article at a particular time. But through the Bureau of Manufactures the permanent

information is also available, which looks to steady trade and offers the means of reaching it. Full commercial directories, lists of chambers of commerce, and similar lists are on file. In addition to these are the lists indicating various dealers and their special lines, with suggestions, sometimes of a confidential character, furnished by the special agents and consular officers.

In justice to the consuls it is suggested that manufacturers who seek further points on subjects concerning which consular reports have been made and lists of addresses given should communicate directly with the Bureau of Manufactures. The complaint of the consuls is not unreasonable that, after making reports on given subjects which are published and are supplemented by the details as to names of dealers, firms, etc., furnished to the Bureau, they receive many letters asking for additional information or for the addresses which are already on file in Washington. They should be relieved of the burden of answering these letters, which are usually due to the carelessness of the writers in not noting the specific statements of what has been forwarded to Washington. The manufacturers themselves who indulge in this careless habit also lose much valuable time, since a letter to the west coast requires from one to two months for an answer to be received, while a Washington reply can be looked for within two or three days.

PREDOMINANCE OF EUROPEANS.

The foreign nationalities doing business on the west coast are many, but the English and the German predominate. In its entirety England has the largest share of the commerce. The English shipping interests have by far the preponderance. In Peru most of the railways are under English control and also some of the best producing copper and other mines and some smelters. The majority of the large commercial houses are English. The banking capital invested is considerable. In Bolivia the English have some of the most valuable tin mines. They control the Bolivia and Antofagasta railway and are in miscellaneous trade. The English interests always have been preponderant in Chile, both because of the shipping and through ownership in the nitrate fields. They have a strong hold on commercial business and are interested in mining exploitation. Most of the agricultural enterprises, such as sheep raising in the Straits of Magellan district, have also been begun and carried forward by English management.

GERMAN PUSH AND ENTERPRISE.

The Germans are the only foreigners who have obtained much of a foothold in Ecuador. They have got into the production of cacao and are in commercial business. Such interests as the Germans have in Peru are of recent origin except the general trade, of which they

have heretofore had a small proportion. Their mining investments are slight, though some of the ores are taken for smelting. However, their influence and their numbers throughout Peru are growing. By engaging in retail business they have transferred much jobbing trade from English to German houses. In Bolivia, while they have not employed much capital in productive enterprises, the general merchandise trade has been largely in their hands. It has been controlled by a few large concerns, some of which were affiliated with the German steamship lines. The German grip on the Bolivian machinery market is being loosened by American competition, and in general trade in the future they are not likely to have a monopoly.

In Chile German capital has been employed in large sums, and for half a century or more there has been a strong German commercial community. The colony which was establshed at Valdivia sixty years ago extended its influence all through the country, and German business interests have been strong at Concepcion, Talca, and other trade centers, as well as at Valparaiso and Santiago. The German investment in the nitrate fields is secondary only to that of the English. The most significant of recent movements is the employment of German banking capital in railway enterprises on the west coast.

ITALIANS, FRENCH, AND CHINESE.

The Italians have large representation in Peru and also in Chile. In Lima they are heavy real estate owners, heads of mercantile houses, own flour mills, and are interested in numerous other enterprises, including steamship lines and banks. In Chile their interests are more distinctly commercial and they have their own banks, but in both countries their presence has resulted in a trade in which they provide not only for their own countrymen, but for all classes of inhabitants. In Ecuador they have a foothold in local trade.

The only French commercial colony on the west coast is in Chile, though there are French commercial houses and some investments in other countries. The darsena or dock at Callao is controlled by a French company. French capital in the future promises to be quite potent in Chile and to furnish a market for French manufactures. The contract for building the new harbor at Valparaiso will undoubtedly increase the commerce of France with Chile. The experiment of the Creusot Works of erecting iron and steel mills at Valdivia and Corsal also means installations of French machinery and perhaps some increase of the permanent market for machinery.

The Chinese colony is centered in Peru, where it numbers about 50,000. In was started sixty years ago by the importation of coolie laborers. Its special wants are supplied by Chinese merchants, who are strong in the commercial community and exercise a marked influ-

ence in financial affairs. Hundreds of "tiendas" or little stores are owned by Chinese with small capital, who get their backing from the large houses.

AMERICANS SPREADING OUT.

Americans are now firmly planted on the west coast in so far as relates to development enterprises. They are spreading out with Panama as the base. The Guayaquil and Quito Railway in Ecuador is an American enterprise. The gold mines in the Zaruma district are owned in New York. One leading mercantile house in Guayaquil is American. The Cerro de Pasco Mining Company in Peru, with an investment which now approximates $20,000,000, is purely American. The Peruvian Mining, Smelting and Refining Company, at Rio Blanco, with an initial investment of $3,000,000, is American. The Inca Mining Company, which controls the gold mines of Santo Domingo, is American, and the same capitalists control the trading company which has the rubber concession, and has put a steamboat on the Tambopato River after building wagon roads and trails to open up that region. There are also other mining enterprises which are operated with capital from the United States. The only railway owned by American capital is that of the Cerro de Pasco Company, but American management is predominant in the operation of the State railways controlled by the Peruvian Corporation.

In Bolivia the railway system which the Speyer-City Bank syndicate is building, in conjunction with the Bolivian Government, represents the investment of $15,000,000 capital from the United States, with the probability that after the completion of the present system more lines will be built with fresh capital. Some tin mines already have been bought by American companies, and there is a certainty of much larger mining investments in tin, silver, and copper mines as the railway system provides transportation facilities. The exploitation of the Lake Titicaca oil fields, both in Peru and Bolivia, is in American hands.

AMERICAN INFLUENCE GROWING.

In Chile copper mines are controlled by American capital; some capital has been put into the placer gold fields in the south, and some of the silver mines are to be exploited by Americans. Capitalists in the United States have not yet entered the nitrate fields, though from time to time rumors are heard of their intention to do so.

The actual investments in mining and railway enterprises and the part taken in developing the west-coast country by Americans already has added considerably to the market for the products of the United States. With so many Americans now engaged in development enterprises and with their natural preference for American machinery

and American articles of consumption these goods become known to the native population also. The increase in the number of Americans on the west coast means also the increase of distinctively American wants. Every American may be considered an advance agent for all kinds of American goods. That the commercial interest of the United States is not larger and that here are so few American mercantile houses is due to the slowness with which Americans engage in commercial business in foreign countries. However, it is inevitable that firms shall grow up whose capital and whose management are American, while at the same time the European and the native houses will be the more disposed to handle American goods.

CONCLUSION.

This knowledge leads to a natural conclusion. Trade conditions on the west coast may be summed up in a nutshell. It is not necessary to await the opening of the Panama Canal for the United States to get increased business in the commercial area that is tributary to the seascoast line from Panama to Valparaiso. The development in the way of railway building, harbor works, exploitation of mines, and enlarging agricultural areas is already providing a larger market and is resulting in greater purchasing power for the inhabitants.

The resources and industries of the west-coast countries are such that they will always be exporters of mineral and tropical agricultural products and importers of manufactured articles rather than of raw materials. Iron and steel products, such as railway material and mining machinery, and a wide range of minor manufactures such as hardware, will have an increased demand. Electrical machinery will have a much larger market with the utilization of the water power of the Andes. The textiles also will have a continuous sale, and breadstuffs, particularly flour, and packing-house products, such as lard and tinned meats, will have an indefinite market.

The shipping facilities are already in process of betterment, the means of communication are being shortened, and mail and passenger service, both so important in facilitating international trade, are being improved. The customs tariffs are regulated on a definite principle and the financial systems for the most part are such as to secure stable exchange. Competition is keen, but it is of a character which alert American business men can meet, and their commerce can be extended by following the suggestions which have been outlined. There is a permanent west-coast trade which within a few years will exceed $300,000,000, and by proper exertions the United States can have more than the $50,000,000 of it which now is held because the march of circumstances is drawing these countries closer commercially to the United States.

APPENDIX.

TRADE TRAVEL ROUTES.

In traveling along the west-coast countries there is little choice of seasons, since so much of the region lies under the Equator. Nevertheless there is some difference in localities which makes it desirable to select certain periods for the visit. Guayaquil's most pleasant season is from June to August, but from June to November the city is not unpleasant, since the rainy season usually does not begin till December. At the end of the continent, where there is a complete reversal of the seasons and the northern midwinter is midsummer, as in Chile, the visit may be made according to preference, though the summer usually is chosen. The winter is less severe than in the same latitude north of the Equator.

The trans-Andean route between Buenos Aires and Valparaiso is usually open from November till May, but the completion of the railway within the next two years will render this route available throughout the twelvemonth. Many travelers now take the steamer to Buenos Aires and cross the mountains or follow around through the Straits of Magellan coming up the coast, but the majority go from New York or New Orleans to Colon, and after crossing the Isthmus continue down the west coast by the vessels of the Pacific Steam Navigation Company or the Chilean line.

The points of interest to commercial travelers and the tributary trade districts are stated below. Detail information regarding steamship itineraries is not given, since the schedules of the different lines vary, and these are always to be had from the New York offices.

COLOMBIA.

Buenaventura is the leading west-coast port of Colombia, and is reached by the smaller coasting steamers of the two lines. The distributing center of this region is Cali, a city of 15,000 inhabitants, three days inland by railway and mule trail. About 30 miles of railway is in operation. Buenaventura is the export point for the gold of the Choco region. Its imports are mining machinery, railway material, and general merchandise.

Tumaco is the port for southern Colombia and is reached also by the coasting steamers. Its exports are straw hats and its imports mining machinery and merchandise.

ECUADOR.

Quayaquil, the commercial center and leading port, is reached in three days by direct steamers from Panama. The Kosmos steamers in both directions also call.

Quito is 290 miles by railway from Guayaquil and the journey is made in two days, the night stop being at Riobamba. Ibarra, the distributing point north of Quito, is 90 miles distant and is reached by mule trail. Cuenca is the most important distributing center of the south. It is 90 miles from the main line of the Guayaquil and Quito Railway, and is reached by mule trail and wagon road.

Esmeraldas, Bahia Caraquez, and Manta are small ports north of Guayaquil, which serve local territory. They are reached by the coasting steamers from Panama or by transshipping at Guayaquil. Zaruma in the southern district is reached overland, the small coasting steamers from Guayaquil making the landing place in a short voyage.

PERU.

Tumbez, the most northerly port, is on the Tumbez River and is at the entrance of a rich agricultural region. Panama steamers do not make regular stops and reliance is had on the auxiliary steamers of the two lines and by coasting vessels from Guayaquil or Paitá.

Zorritos and Tulara are in the district of oil production. They are reached by coasting vessels and direct oil steamers from Callao.

Paita is the leading port in northern Peru and has a good harbor. It is the quarantine station for vessels from the north. The railway runs to Piura, 60 miles. Piura is the center of the cotton-growing industry, the fine wool cotton being produced in this region only. This district is also the field of extensive irrigation canal systems.

Eten is the port of the rice district and has short railways running to Ferrenafe and Cayalti. It is also the northern stopping point for the auxiliary coasting steamers, which run as far south as Valparaiso.

Pacasmayo is the outlet for sugar production and the entrepôt for the Amazon trail. The railway runs to Yonan and is being extended farther into the interior. Cajamarca, Moyabamba, and other important interior towns on the Amazon route are served through Pacasmayo.

Salaverry is the port for Trujillo and the surrounding sugar country. The railway runs to Ascope and beyond. Trujillo is an important trade center.

Chimbote, Supe, and Huacho are small ports with short railway spurs for lateral valleys extending to the foothills of the mountains and are reached by the coasting steamers, which include them in the regular itineraries between Callao and Eten.

Callao is the central port of Peru and is 8 miles from Lima. All of the importing houses whose headquarters are at Lima have local branches in Callao. The Central Railway runs 138 miles to Oroya, in the heart of the Andes. The most important stations on this railway are Matucana, Chicla, and Casapalca. Big smelter works are located at Rio Blanca and Casapalca. From Ticlio, at the entrance to the Galera tunnel, a short railway spur runs to the Morococha mines.

Oroya is the inter-Andean railway crossroads. A line runs to Cerro de Pasco 83 miles north and a prolongation is being made south to Huancayo. This southern prolongation passes through the rich agricultural valley of Jauja. Ayacucho, an important interior town, is reached by mule trail through the Huancavelica mining district.

Cerro de Pasco is the headquarters of the Cerro de Pasco and numerous independent mining companies. The permanent population is 10,000. The smelter is located 8 miles from the town, but all commercial business, distribution of supplies, etc., is from Cerro. A branch railway line 25 miles in length runs to the coal mines at Gollarisquisca.

Tarma is an important place on the Amazon watershed and is at the entrance of the Amazon River region. It is reached by wagon road and mule trail from Oroya or Cerro de Pasco in five hours.

The railway journey from Callao or Lima to Cerro de Pasco is made in one day, the train leaving Lima at 6 o'clock in the morning and arriving at Cerro de Pasco at 9 o'clock at night. Most travelers, on account of soroche or mountain sickness, find it preferable to stop over night at Matucana. Cerro de Pasco is 14,200 feet and the Galera tunnel 15,665 feet above sea level.

Cerro de Azul is a small port 90 miles south of Callao, and is the center of a rich cotton and sugar district. The regular steamers call for freight and passengers.

Pisco is an important port and is the outlet for the Ica Valley, which is noted for its agricultural and fruit products. The railway runs from Pisco to Ica, 40 miles.

Mollendo is the most important port of Peru after Callao. All southern Peru and much of Bolivia is served through it. The Southern Railway extends to Puno, on Lake Titicaca, 325 miles.

Arequipa, a town of 35,000 inhabitants, 107 miles from Mollendo, is the distributing center for southern Peru and is the headquarters of many leading importing firms, and also exporters of minerals, rubber, and wool. Trains leave Mollendo for Arequipa daily.

Cuzco is the center of a thickly populated agricultural region and serves the commerce of the districts reaching to the navigable rivers of the Atlantic watershed. Most of the Arequipa commercial houses have branches in Cuzco, but there are some independent concerns. Trains leave Arequipa triweekly, branching from Juliaca and through Sicuani to Checacupe, 70 miles from Cuzco, to which the railway is being extended. The existing means of transport between Checacupe and Cuzco are mules and stage coaches.

Puno, on Lake Titicaca, is the Peruvian customs port and is the distributing center for the surrounding agricultural district.

Ilo is the most southerly port of Peru and is the outlet for the Moquegua agricultural district.

BOLIVIA.

Bolivia is accessible by railway through either Mollendo or Antofagasta. Panama passengers enter at Mollendo and leave at Antofagasta, making the through trip by rail, a distance of about 1,150 miles.

Guaqui is the Bolivian customs port on Lake Titicaca. Trains leave Arequipa semiweekly for Puno, connecting with the boats for Guaqui. The voyage across the lake takes twelve to fifteen hours.

La Paz, the seat of government, is on the railway 50 miles from Guaqui. The city is the headquarters of many large importing firms. Sorata, the Yungas region, and the tropical slopes are served from La Paz.

Oruro is the prospective Bolivian trade center. It is on the central plain 143 miles from La Paz and 168 miles from Guaqui by railway, the road branching at Viacha. It is also the terminus of the Antofagasta and Bolivia Railway from Antofagasta. From Mollendo to Oruro the distance is 600 miles; from Antofagasta 575 miles. Oruro is the heart of the tin-mining industry.

Cochabamba is the center of a good agricultural district, 100 miles by stage route from Oruro, but a railway is to be built.

Potosi is the center of the silver-mining region and has a large commerce. It is reached by stage line, but a railway is to be built connecting it with Oruro.

Sucre, the titular capital, is reached from Chillapata, on the railway line, by stagecoach. It is the richest city in Bolivia and serves a somewhat isolated district.

Uyuni is a junction point on the Bolivia and Antofagasta Railway. The Pulacayo silver mines are 9 miles distant at Huanchaca, and are reached by a railway spur. Uyuni has several large distributing warehouses. The railway completing the connection between Lake Titicaca and Argentina will start at Uyuni and continue to Tupiza, in southern Bolivia. Some of the commercial wants of this southern district are now served from Uyuni.

CHILE.

Arica is under Chilean customs and administrative control. It is the outlet for the rich valley extending to Tacna, with which it is connected by a railway 40 miles in length. Formerly Arica was the entry port for a large section of Bolivia, the goods being conveyed across the Atacama desert by pack trains. The railways from Mollendo and from Antofagasta decreased this traffic, but Bolivia still maintains a customs agency, and small quantities of goods are imported and exported by this route. Arica's future importance is in the construction of the railway to La Paz. This will make it an active port during the construction period, and when the railway is completed it will be the inlet and outlet for the Corocoro copper fields and for general merchandise to Bolivia. Considerable expenditures also will have to be made on harbor improvements.

Pisagua is an important nitrate exporting point and the center of imports of supplies and general merchandise for the surrounding districts. The steamship may be left at Pisagua and the Nitrate Railway be taken to Iquique, a day's journey.

Iquique is the leading nitrate shipping port. Heavy imports of merchandise are made for supplies for the nitrate workers and also machinery, railway material, etc., for the nitrate establishments. Most of the leading west coast mercantile firms have branches here. A number of small ports, some of which have short railway spurs to the nitrate fields, are between Iquique and Antofagasta and are served by the coasting vessels.

Antofagasta is, after Iquique, the chief nitrate port. It is the beginning of the Antofagasta and Bolivia Railway. In addition to nitrate, shipments of copper and silver ore from the mines in the interior are made through this port. American smelting and refining interests are represented and the largest ship supply house is Ameri-

can. The imports are general merchandise and supplies, mining machinery, and railway material.

Mejillones is a few miles north of Antofagasta. It has a fine harbor, in contradistinction to Antofagasta, and has been made a customs port by the Chilean Government. A spur of the Antofagasta and Bolivia Railway runs from Mejillones to the main line, and extensive terminal facilities have been established by the railway company. Mejillones, on account of its good harbor, is assured of growth as a commercial port. Several Antofagasta houses have branches at Mejillones.

Calama is the most important interior Chilean town on the Antofagasta and Bolivia railroad, and is 100 miles from Antofagasta. It lies in a narrow valley as distinguished from the surrounding desert, and has some agricultural production. Besides the nitrate establishments Calama is a center of copper mining.

Caldera is the outlet for Copiapo and the surrounding district, with which it is connected by a short railway.

Coquimbo is a port of some importance, and is a distributing center for general merchandise and an exporting point for ores. The Panama steamers stop at Coquimbo.

Valparaiso is the largest city on the Pacific coast with the exception of San Francisco. Its shipping business is very great. In addition to supplying contiguous territory it is a port of transshipment for cargo from Panama south and from the Straits of Magellan north. Most of the leading west-coast houses have their headquarters at Valparaiso.

Santiago, the capital, with 350,000 inhabitants, is the largest west-coast city, and is five hours from Valparaiso by rail. It is a center of large jobbing trade which is usually carried on in connection with Valparaiso. Santiago is at the head of the central valley, and from it the railway may be taken as far south as Valdivia and Puerto Montt in preference to the coasting vessels from Valparaiso.

Talca is an important agricultural and trading center south of Santiago on the railway.

Concepcion, in the central valley, 350 miles from Santiago, ranks in commercial importance next to Valparaiso and Santiago. It is reached by the railway from Santiago and also by the short spur from the port of Talcahuano.

Valdivia is the commercial metropolis of southern Chile, and is the seat of industrial establishments as well as of agriculture and commerce. It is reached by a short railway spur from the port of Ancud, as well as by the railway prolongation from Concepcion.

Puerto Montt is at the head of the Chiloe Archipelago and has some commercial importance. It is the center of timber industry.

Punta Arenas, in the Straits of Magellan, is the southernmost point on the continent, and is the headquarters for the sheep-raising industry, as also placer gold mining. Punta Arenas is a free port and has a large trade in supplying vessels.

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COTTON FABRICS IN MIDDLE EUROPE:

GERMANY, AUSTRIA-HUNGARY, SWITZERLAND

By

W. A. GRAHAM CLARK

Special Agent of the Department of Commerce and Labor

WITH REPORTS FROM VARIOUS CONSULAR OFFICERS

JANUARY 4, 1909

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LETTER OF SUBMITTAL.

DEPARTMENT OF COMMERCE AND LABOR,
BUREAU OF MANUFACTURES,
Washington, October 22, 1908.

SIR: I have the honor to submit herewith a series of reports from Special Agent W. A. Graham Clark on the cotton-manufacturing industry in Germany, Austria-Hungary, and Switzerland.

The methods and machinery used in the manufacture of cotton textiles, notably those specialties which find a large market in the United States, the wages paid, and other matters incidental to the cost of production, are described in appropriate chapters in such a manner as to be of value and interest to American manufacturers. To these reports have been added a number from consular officers in various sections giving additional matter of value.

Respectfully,

JOHN M. CARSON,
Chief of Bureau.

To Hon. OSCAR S. STRAUS,
Secretary of Commerce and Labor.

COTTON FABRICS IN MIDDLE EUROPE.

INTRODUCTION.

Although cotton manufacturing is an old industry in Germany, having been carried on by hand for many years previous to the introduction of machinery, it was not until 1879 that any great advances in production were made. For a long time Germany obtained the bulk of its cotton goods abroad, mainly from England, but its output has steadily grown in importance until now it is only exceeded by the United Kingdom and the United States in the extent of its manufactures.

The rate of growth in the different sections has not been the same. Saxony is the leading State in cotton manufacturing and has nearly trebled its spindles in the last twenty years, but its increase has been even greater in special lines like knitting and embroidering. Westphalia, on the Rhine, has shown the most remarkable progress in the number of spindles, having in 1905 nearly seven times as many spindles as in 1887. The total number of spindles in the Empire in 1887 was 5,054,795, which consumed 1,006,983 bales of cotton, and in 1905 they had increased to 8,832,016, with a consumption of 1,761,369 bales of cotton, an increase of approximately 75 per cent both in spindleage and cotton consumption. There are 21 towns having more than 100,000 spindles each, and these 21 towns united have more than half the spindles in Germany. The number of looms in operation in 1905 was estimated as 231,199. The weaving industry is more scattered, and there are more than 50 towns with over 1,000 looms each. The average spinning mill has 26,500 spindles, and the average weaving mill 364 looms.

GERMAN VERSUS AMERICAN EXPORTS OF COTTON GOODS.

The importance of Germany's output of cotton goods is shown by the fact that next to Great Britain it is the largest exporter of such goods in the world. The German export trade is devoted more particularly to special lines, such as knit, embroidered, braided, and similar products, rather than to the regular cotton cloths and yarns.

In the calendar year 1907 Germany exported cotton goods to the value of $89,015,570 and cotton yarns to the value of $7,886,566, or a total of $96,902,136. This total would doubtless have exceeded $100,000,000 for the year but for the financial depression in the best foreign markets during the closing months.

In the same period the United States exported $294,012 worth of cotton yarn, $14,900,421 of cotton cloths, $5,147,748 of wearing apparel, and $3,401,299 of other manufactures, or a total for cotton manufactures of $23,742,480, a little less than one-fourth the amount of similar exports from Germany. Statistical tables include also $2,579,582 worth of cotton waste among American exports of manufactured goods, which can not be considered as a credit item to the industry, but rather as a debit. The largest share of the cotton waste and linter exports goes to Germany, where they are converted into valuable textile products. The exports of raw cotton from the United States to Germany alone in 1907 reached $131,353,656, or over five times the value of the export of cotton manufactures from the United States to the entire world.

THE AMERICAN MARKET—CONCENTRATION OF SPECIALTIES.

The German export of manufactured cotton goods is of interest to the United States, not so much for its competition in foreign markets as for its competition with American cotton goods in the home market of the latter. It is largely due to the market afforded in the United States to German cotton manufacturers that their export business has increased with such strides, having advanced from $54,500,000 in 1899 to $97,000,000 in 1907. At present Germany occupies the third place in supplying the vast amount of cotton textile manufactures purchased abroad by the United States, being surpassed only by the United Kingdom and Switzerland. This trade has been steadily increasing yearly, and in the fiscal year ended June 30, 1907, Germany sent $18,212,531 worth of cotton manufactures to the United States, over two-thirds of which consisted of knit goods, laces, and embroideries.

Each special branch of cotton manufacturing in Germany tends to concentrate in some particular section and around some particular town. Chemnitz is known for hosiery, Plauen for embroidered laces, Gera for fine dress goods, Crimmitzschau for vigogne yarn, Augsburg for fine spinning, Mulhausen for fine weaving, Elberfield for colored goods, Crefeld for velvets, and Barmen for braided work.

NATIONAL INSURANCE LAWS—TRADES UNIONS.

Paternal laws have been enacted in Germany of more far-reaching character than those adopted by any other nation, and prominent among such laws are those in regard to compulsory insurance of workmen, which apply to all workers in Germany, textile or otherwise. Every worker, whether male or female, who receives under 2,000 marks ($476) a year has to insure against sickness and against old age or invalidism, and has to be insured by his employer against accident.

Nearly one-tenth of the German workers are now estimated to belong to some trades union. The rapid increase of unions among the workers has within the last few years led to similar organizations being formed among the employers for mutual protection.

IMPORTS OF COTTON INTO AUSTRIA-HUNGARY.

The imports of raw cotton into Austria-Hungary in 1907 amounted to about $50,000,000, of which 67 per cent, or $33,500,000 worth, was supplied by the United States. Nearly the whole of the American cotton is imported via Bremen, Germany, and is included in the American exports to Germany, the direct shipments into Austria-Hungary last year, according to United States statistics, being but a trifle over $6,000,000. The total imports of raw cotton in 1907 showed an increase of over $7,500,000 over the previous year, owing to the expansion in the home consumption of cotton goods, though there has also been a steady growth in the export trade.

The exports of cotton manufactures from Austria-Hungary in 1907 amounted to about $12,500,000, of which less than $300,000 worth was sent to the United States.

COTTON MANUFACTURING IN AUSTRIA.

Cotton manufacturing is the leading industry of Austria, and is steadily advancing in importance. It is estimated that on January 1, 1907, there were 3,512,122 spindles in operation, to which about 600,000 spindles were added during the year, making the total over 4,000,000 spindles. The majority of the spindles are mule, this class being estimated as about double the number of ring spindles. The quality of the production has also been raised, and the mills now produce yarns and cloth that were formerly exclusively imported.

The majority of the mills are small, and are mostly of private ownership, there being but 22 mills operating over 50,000 spindles each. The tendency is for companies owning several small plants to gradually build up the ones best located and drop the others. The most important mills are located in Bohemia, which now contains about 60 per cent of the mills of Austria.

There is great variation in wages between the different sections and between the town and country mills in the same section. From wage lists obtained at various mills it would seem that 50 cents per day might be taken as the average cotton-mill wage in Austria.

GOVERNMENT AID TO MILLS IN HUNGARY.

The manufacture of cotton goods is yet in its infancy in Hungary. On January 1, 1907, the number of spindles was estimated as 139,682, to which additions were made during the year so that the total number reached perhaps 200,000. The present consumption of cotton is about 50,000 bales a year. Mills make mainly coarse goods, Cabots,

and some colored goods. The skilled help employed comes mainly from Austria.

In order to accelerate the growth of the cotton industry the Hungarian Government grants a number of important concessions to new mills in the way of exemptions from various classes of taxes, reduced rates and other privileges from the state railways, and a state subsidy equal to one-fourth of the capital stock, payable in ten yearly installments. It is expected that these measures will result in the industry being largely increased in the next few years.

PRODUCTION OF SPECIALTIES IN SWITZERLAND.

The Swiss cotton industry is an old one, and Switzerland was one of the first countries to take advantage of the English inventions in the early development of cotton manufacturing. Swiss cotton mills now stand in the front rank in the production of fine yarns and cloth, and in some lines their only competitor is Great Britain. However, the cotton mills have remained almost stationary for the last ten years, and only in special lines of manufacturing, such as the embroidery business, has there been any progress. The advance in this direction has been of great help in enabling the mills to find an outlet for their cloth and yarn.

At the beginning of the present year there were in operation 1,499,170 spinning spindles, with 9,900 operatives; 117,782 doubling spindles, with 2,342 operatives; and 22,709 looms, with 13,854 operatives.

About 60 per cent of the raw cotton used in Swiss mills is American, the imports from the United States in 1906, the latest figures available, being 30,111,268 pounds. The imports of cotton goods are steadily increasing, owing to the embroidery industry.

The imports of manufactured cotton goods into the United States from Switzerland during the past two fiscal years ended June 30 have been as follows:

Articles.	1907.	1908.
Cotton cloths	$738,213	$569,005
Knit goods	250,062	263,966
Laces and embroideries	13,979,808	13,209,483
	14,968,083	14,042,454

Importations of miscellaneous Swiss cotton manufactures aggregate about $500,000 annually in addition to the foregoing.

GERMANY

EXPORTS OF COTTON GOODS.

REVIEW OF THE VAST AND GROWING TEXTILE TRADE—EXCEEDED IN IMPORTANCE ONLY BY GREAT BRITAIN.

In the calendar year 1907 Germany exported cotton yarn to the value of $7,886,566, and cotton goods to the value of $89,015,570, or a total of $96,902,136. If it had not been for the financial depression in her best markets during the last months of the year this total would have been considerably over $100,000,000. In the same year the United States exported $294,012 of cotton yarn, $14,900,421 of cotton cloths, $5,147,748 of wearing apparel, $2,579,582 of cotton-mill waste, and $3,401,299 of other cotton goods, or a total for cotton manufactures of $26,323,062. Next to Great Britain Germany is the largest exporter of cotton manufactures in the world.

Cotton manufacturing is an old industry in Germany, but it was not until about 1879 that there began the development of the modern German cotton manufacturing industry, and not until some ten years later that the export business began to attain such large proportions. Since then it has steadily, though with occasional setbacks, increased until it has reached its present strength and occupies the proud position of having in the last year exported nearly four times as much manufactures of cotton as did the United States.

GERMAN TEXTILE SPECIALTIES.

The German export of manufactured goods is of interest to the United States, not so much for its competition with American cotton fabrics in foreign markets as for its competition with American cotton goods in the home market of the latter, and it is largely due to the market afforded German cotton manufacturers in the United States that their export business has increased with such strides. A striking instance of the extent to which their factories depend on the American trade is now shown at Chemnitz, Plauen, Crefeld, Barmen, etc., where I have found factory after factory running short time and a good many closing down owing to the falling off in American orders.

There are two noticeable points about the German export trade in cotton manufactures. One is that it does not depend on regular cotton cloths and yarn, but more on what might be called special lines, such as knitting, embroidering, braiding, etc. Another is that Germany does comparatively little business in cotton manufactures with uncivilized or semicivilized countries, but depends mainly on Europe and America for her markets, looking especially to the great cotton manufacturing centers of Great Britain and the United States. After these two countries Germany sells the next largest amounts to

Austria-Hungary, the Netherlands, Russia, and other European countries, and smaller amounts to India, Chile, Argentina, and Brazil. To all other countries of the world, including China, her shipments of cotton manufactures are very small. Roughly speaking, three-fifths of the cotton exports go to Europe, one-fifth to North America, and the remaining one-fifth to the rest of the world.

COTTON IMPORTS—UTILIZATION OF LOW-COST FIBER.

A large proportion of the exports of German cotton manufactures consist of cheap goods and Germany uses a large amount of cheap cotton. Next to Japan it is the largest importer of Indian cotton. Ordinarily Germany imports some 70 per cent of her cotton from the United States, 20 per cent from India, 8 per cent from Egypt, and 2 per cent from other countries. In 1907 the total amounted in value to $127,765,064, distributed by weight as follows:

Imports from—	Pounds.	Imports from—	Pounds.
United States	714,719,291	Togoland	498,765
British India	238,045,885	Haiti	368,288
Egypt	80,298,993	German West Africa	327,735
Dutch India	6,588,858	Unclassified	1,023,318
Mexico	3,691,039		
Turkey in Asia	2,256,235		1,050,026,374
China	2,207,967		

Part of the Indian cotton is used in the German home trade and part is exported in the shape of yarn to Hungary and other places, though a large portion is mixed with American cotton and used to lower the price of export goods.

Germany can not compete with England on very fine goods, with Switzerland on very fine embroideries, with the United States in a pure sized sheeting, nor with India on cheap yarns, and the Empire can not compete with Italy on cheap colored cottons to any very large extent. Germany has therefore confined export textile manufacturing largely to the making of certain specialties, like hosiery, gloves, etched lace, edgings, braids, etc.

The main cotton manufactures exported from Germany in order of value are (1) colored goods, (2) hosiery, (3) knitted gloves, (4) lace, (5) yarn, (6) embroidery, (7) trimmings. The knit goods industry is one of the most important of the export producing lines, and its steady growth accounts for the increase of shipments of cotton manufactures to the United States.

EXPORTS DOUBLE IN A DECADE.

In the last ten years Germany's export of cotton goods has about doubled. The steady progress made is shown by the following table, the amounts representing millions of dollars:

Description.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.
Cotton goods	49.05	58.24	52.31	61.69	71.78	80.18	90.49	93.68	89.00
Cotton yarn	5.45	6.92	6.78	7.54	7.74	7.09	8.11	7.64	8.00
Total	54.50	65.16	59.09	69.23	79.52	87.27	98.60	101.32	97.00

The imports of cotton manufactures into Germany for the same years, in millions of dollars, were as follows:

Description.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.
Cotton goods	7.74	8.38	7.47	8.26	8.64	9.66	10.71	13.33	14.50
Cotton yarn	13.23	14.97	11.57	12.19	14.30	15.90	14.54	19.61	29.17
Total	20.97	23.35	19.04	20.45	22.94	25.56	25.25	32.94	43.67

EXTENT OF THE YARN TRADE.

In regard to the imports it is seen that the principal item is yarn. Those mainly imported into Germany are fine yarns for use in special lines like embroidery and lace making. The exports in this branch consist mainly of thread and of coarse yarns. The numbers of the regular yarns imported into and exported from Germany—not considering vigogne and special yarns—were, in pounds, as follows for the year 1907:

Kind.	Single yarns.				Ply yarns, single twist.			
	Unbleached.		Bleached, dyed, or printed.		Unbleached.		Bleached, dyed, or printed.	
	Imports.	Exports.	Imports.	Exports.	Imports.	Exports.	Imports.	Exports.
Under No. 11	4,148,810	2,970,992	918,186	3,670,542	255,884	230,098	126,950	417,658
Nos. 11 to 16	6,600,980	938,243	499,426	892,400	113,726	119,898	36,366	324,649
Nos. 17 to 21	7,120,683	569,954	63,034	1,379,701	216,874	144,362	31,076	453,804
Nos. 22 to 31	9,706,857	755,311	31,517	900,554	1,684,297	197,919	27,550	408,842
Nos. 32 to 46	13,374,533	374,680	43,419	952,569	5,853,824	81,768	17,632	450,938
Over No. 47	17,484,332	66,781	7,715	245,525	19,175,461	322,665	34,824	992,682
Total	58,436,195	5,675,961	1,563,297	8,041,294	27,300,066	1,096,710	274,398	3,048,573

The largest quantities imported are seen to be gray yarns above No. 47, part single and part doubled. The exported yarns are seen to be mainly the coarse numbers. The bulk of the yarn imported (in 1907, 71,464,700 pounds out of 88,381,282) comes from Great Britain, with small quantities from Switzerland, India, and France. The yarns exported go mainly to European countries, Holland, Great Britain, Austria-Hungary, etc., and there are comparatively small shipments to other countries. They do a small business in this line in Turkey and Argentina, but very little in China, India, etc.

LAST YEAR'S IMPORTS AND EXPORTS.

The following table shows the weight and value of cotton and cotton manufactures imported into and exported from Germany in 1907:

Description.	Imported.		Exported.	
	Pounds.	Value.	Pounds.	Value.
Cotton in bales	1,050,026,374	$127,765,064	112,333,031	$13,804,238
Bleached cotton	370,052	54,264	4,125,227	623,560
Total cotton	1,050,396,426	127,819,328	116,458,258	14,427,798
Roving and slubbing	8,155	1,190	46,504	8,330
Vigogne yarn	----------	----------	1,123,820	175,882
Single yarns:				
Bleached, dyed, or printed	58,436,195	16,290,624	5,675,961	1,011,262
Unbleached	1,563,297	300,118	8,041,294	1,787,380
Ply yarns:				
Single twist, unbleached	27,300,066	12,208,448	1,096,710	308,686
Single twist, bleached, dyed, or printed	274,398	83,300	3,048,573	1,129,072
Cable twist, unbleached	58,406	34,034	322,886	174,454
Cable twist, bleached, dyed, or printed	31,738	19,516	721,389	412,980

Description.	Imported.		Exported.	
	Pounds.	Value.	Pounds.	Value.
Cotton thread	708,887	$353,668	7,033,184	$2,850,962
Unclassified yarns			39,672	27,608
Total yarn, etc.	88,381,142	29,290,898	27,149,973	7,886,566
Unbleached cloths, weighing per square meter—				
80 grams or over	10,077,790	3,917,718	3,371,679	1,302,098
40 to 80 grams	2,144,712	1,036,014	2,016,219	973,182
Under 40 grams	331,041	319,872	292,250	282,268
Dressed or bleached cloths	2,259,320	1,097,894	7,936,384	3,770,872
Cloths dyed, printed, or colored	2,616,148	1,276,870	58,305,226	25,210,388
Knitted and netted stuffs	54,218	24,038	596,743	270,605
Gloves	12,342	29,274	4,743,008	11,267,872
Stockings or socks	35,705	34,034	19,660,121	18,929,330
Underclothing	40,113	19,278	7,984,431	3,699,234
Fishing nets	406,418	101,626	511,769	267,512
Other knitted or netted goods	9,918	6,902	2,834,564	1,974,686
Lace of all kinds	619,544	2,007,054	4,556,329	9,098,026
Embroidery on cotton foundation	387,684	1,036,490	3,146,430	6,716,598
Velvet and plush tissues	1,984,702	973,896	2,602,704	2,279,802
Fire and other hose and girths	97,196	36,414	2,511,678	812,294
Furniture and upholstery goods	311,646	252,518	1,250,990	738,276
Open woven tissues for curtains	40,994	60,452	716,080	511,938
Wicks, woven or plaited	7,714	2,380	841,267	228,718
Tulle	1,038,525	2,130,814	135,987	205,632
Edgings, ribbons, tapes, etc.	105,131	113,526	147,448	113,288
Cotton felts	16,971	5,712	245,746	75,208
Rope, cord, or twine	42,758	10,234	125,408	32,844
Unclassified			193,732	254,899
Total cloth, etc.	22,640,590	14,493,010	124,726,193	89,015,570
Total cotton manufactures		43,783,908		96,902,136

DISTRIBUTION OF FABRIC PRODUCTIONS.

As noted in the statistics the cotton goods go mainly to other European countries and the United States, with smaller quantities to other regions. Of the small amount of gray goods shipped the largest consumers are Great Britain and Switzerland. Included in this are muslins, shirtings, and some sheetings. The bleached goods consist of muslins, calicoes, and similar goods, besides smaller amounts of a wide range of varieties. The largest market is the United States, then Great Britain, Switzerland (mainly muslin for embroidery foundation), Argentina, etc. The goods comprised under the head of colored, dyed, and printed goods amount to over $25,000,000 and are scattered abroad more widely than any of the other products of the German cotton mills. The main markets found for these goods and the amounts sent to each in 1907, in pounds, were as follows:

Country.	Pounds.	Country.	Pounds.	Country.	Pounds.
United States	1,611,124	Holland	3,419,065	Switzerland	2,673,232
Great Britain	7,401,472	Brazil	3,341,586	Roumania	2,398,513
India	4,739,922	Turkey	3,113,150	Belgium	1,893,677
Argentina	4,142,198	Chile	2,934,185	Egypt	1,832,538

Included under this heading is a wide range of goods from the coarsest checks and stripes to Jacquard work. The bulk of these goods is of medium grade. Some of the prints shipped from Mulhausen are very fine goods and rival those of the English and French. Under the head of knit goods, the gloves are taken by Great Britain and the United States; of the hosiery half goes to the United States, and of the knitted underclothing over half is taken by Great Britain. Of the lace exported over [illegible] es to the United States and nearly a

third to England, while of the embroidery over a third goes to Great Britain and nearly a third to the United States. These laces are mainly the Plauen etched lace, while the embroidery is mainly of a cheaper grade of work than that produced at St. Gall. Velvets and plushes exported go to Russia, United States, India, etc. Furniture and upholstery goods find their best market in Great Britain. Edgings, ribbons, tapes, etc., go to Great Britain and the United States.

The foregoing brief classification of the main countries buying Germany's cotton goods shows what an important position is held by the American trade. The United States takes one-half of the hosiery exported from Germany, one-third of the gloves and a third of the lace, besides large quantities of other cotton manufactures, especially those produced on the braiding machine and the ribbon loom.

LARGE SHARE IN IMPORTATIONS OF UNITED STATES.

Germany occupies the third place in supplying the vast amount of cotton textile manufactures bought from abroad by the United States every year. This is shown by the following table giving details of American purchases of the leading articles from the four countries which together supplied three-fourths of the $79,524,943 worth of cotton manufactures imported into the United States in the calendar year 1907:

Country.	Cloth.	Knit goods.	Laces and embroideries.
United Kingdom	$11,642,816	$117,313	$7,256,131
Switzerland	692,323	267,513	15,574,414
Germany	588,703	8,384,830	5,341,332
France	1,133,301	400,643	12,260,861
Other countries	370,815	38,878	1,010,625
Total	14,427,958	9,209,177	41,443,363

It is seen from this that in the main Great Britain ships to America cloth and laces, Switzerland only embroideries, and France mainly laces, while Germany ships largely knit goods and embroidered laces.

The textile exports from Germany to the United States have been steadily increasing for some years, the increase being mainly represented in the knit goods line, which more than makes up for decreases in some other lines. The following figures show how the knitted goods and stitched goods have been increasingly imported into the United States from Germany in the last few fiscal years ending June 30:

Description.	1903.	1904.	1905.	1906.	1907.
Cloths:					
Plain	$1,878	$4,991	$16,090	$10,954	$13,961
Bleached, dyed, or printed	603,467	532,613	533,287	532,196	563,639
Clothing, not including knit goods, but including gloves	1,487,015	1,722,961	1,521,338	1,795,224	2,521,467
Knit goods	5,472,059	5,449,903	5,504,843	6,383,371	7,830,986
Laces, embroideries, etc	4,540,612	4,545,545	5,331,326	6,044,151	5,425,317
Plushes, etc					243,553
Yarn and warp	354,121	419,016	375,499	555,783	434,500
All other	1,677,134	1,481,567	1,050,380	1,137,936	1,179,108
Total	14,136,286	14,156,596	14,332,763	16,459,615	18,212,531

METHODS CONDUCIVE TO SUCCESS.

Germany's vast sales of cotton manufactures to the United States are largely due to the fact that German manufacturers ship special lines and cater to the demand in these lines. Thus in etched laces there are at Plauen large numbers of designers continually getting out new samples and the manufacturers are willing to make up any size orders desired and pack as desired. In hosiery there are new varieties coming out all the time; likewise in gloves, hat braids, passementerie, etc. The German designers frequently get ideas from the United States, but their willingness and ability to make small lots of a large number of special designs is one factor that has had a great deal to do with their American sales.

Germany sends out large numbers of commercial travelers and these men are usually good linguists and well versed in their business. They meet the buyer personally, offer long credits in such countries as Turkey and Egypt, cater to the buyer's taste as to marking, packing, etc., and are very persistent in their efforts to make sales. Other factors that have largely helped German sales in some sections, especially in South America, have been the presence of large colonies of German emigrants. The increasing merchant fleet of Germany offers a ready means of shipment under their own flag to any part of the world, and the Germans are more and more following the precedent so long followed by England of the banker working hand in hand with the merchant in developing foreign fields and establishing branch banks wherever good trade prospects are to be found. The latest instance of this is the chain of banks now being established by German capital in the leading towns of the Levant.

GROWTH OF MANUFACTURES.

NUMBER AND EXTENT OF THE FACTORIES—PROFITS REALIZED—PAY AND PRIVILEGES OF EMPLOYEES.

In the manufacture of cotton goods Germany holds third place, being only exceeded by the United Kingdom and the United States. In the exports of cotton goods Germany is only exceeded by the United Kingdom. Raw cotton is the largest single import of Germany, and manufactured cotton the largest export. In 1907, the imports of raw cotton amounted to 933,938,168 pounds, valued at $113,391,530, and the exports of cotton manufactures amounted to 151,916,167 pounds, valued at $97,002,136. The average value of the cotton imported was 12.14 cents per pound, and the average value of the manufactured product was 63.84 cents per pound.

Cotton manufacturing is an old industry in Germany, and before the introduction of machinery there were well-known centers of weaving, knitting, braiding, lace making, etc., in Saxony and on the Rhine. The German people were slow to avail themselves of the introduction of modern machinery, so that many local hand industries were stifled by the flood of machine-made goods from other countries, and for a long time Germany obtained the bulk of its cotton goods abroad, mainly from England. The unification of the German Empire in 1870 awakened the national spirit, and, encouraged by a firm central Government, there began an agitation for the manufacture of cotton goods at home. The 1,500,000 spindles taken over with Alsace-Lorraine put the German industry ahead of the French, and this lead was further widened by the increased momentum in the cotton-manufacturing industry about 1879. Since then there has been no very remarkable spurts, but a gradual and steady growth.

INCREASED PRODUCTION BY STATES.

The rate of growth in the different sections has not been the same. Saxony is the leading German State in cotton manufacturing, and has nearly trebled its spindles in the last twenty years, but its increase has been even greater in special lines like those of knitting and embroidering. The State that has shown the most remarkable progress is Westphalia on the Rhine, which had nearly seven times as many spindles in 1907 as it had in 1887. That part of Hanover near the cotton center in northern Westphalia shows a large comparative increase, and so does Wurttemberg, both of these having more than doubled their number of spindles. Bavaria and the Rhine Province also show substantial increases; Alsace a very slight increase. The Alsatian mills,

however, have advanced further than the others in the direction of fine goods, which can be seen from the fact that while they have increased in spindleage 10 per cent there has been a 4 per cent decrease in their consumption of cotton.

The following statistics, furnished by the Bremen Cotton Bourse, shows the number of spindles and the amount of cotton consumed in the several kingdoms and provinces of Germany in 1887 and in 1905:

Kingdoms and provinces.	1887.		1905.		Increase.	
	Spindles.	Cotton consumed.	Spindles.	Cotton consumed.	Spindles.	Cotton consumption.
	Number.	*Bales.*	*Number.*	*Bales.*	*Per cent.*	*Per cent.*
Saxony	541,122	90,505	1,321,288	225,000	144.2	148.6
Saxony, vigogne spinning	460,447	102,200	628,025	163,085	36.4	59.6
Bavaria	924,312	161,516	1,578,084	300,000	71.0	85.7
Alsace-Lorraine	1,375,000	250,000	1,511,586	240,000	9.9	[a] 4.0
Westphalia	285,828	59,500	1,172,222	255,300	310.1	329.0
Rhine Province	435,802	165,580	1,051,362	287,090	58.5	73.4
Wurttemberg	354,548	54,390	706,585	115,000	99.3	111.4
Baden	398,172	58,562	468,784	80,134	17.7	36.8
Hanover	105,000	18,350	211,740	48,425	101.6	164.0
Silesia	75,064	21,500	109,320	28,315	45.6	31.7
All others	99,500	24,880	73,020	19,020	[a] 26.7	[a] 30.0
Total	5,054,795	1,006,983	8,832,016	1,761,369	74.7	74.9

[a] Decrease.

The German Empire is composed of the 3 free cities of Hamburg, Bremen, and Lubeck; of the 4 kingdoms of Saxony, Bavaria, Wurttemberg, and Prussia (the latter having 13 provinces); 7 princedoms, 6 grand duchies, 5 duchies, and the Imperial Province of Alsace-Lorraine. Cotton manufacturing is almost exclusively contained in the four kingdoms and the Imperial Province. East of Saxony, with the exception of a few towns in Silesia, there is no cotton manufacturing, and in the Kingdom of Prussia itself there is practically none except in the two western provinces.

THE CENTERS OF MANUFACTURE.

German cotton manufacturing is more scattered than the English, Swiss, Italian, or East Indian, but there are three well-defined centers—the Saxon, the Alsatian, and the Westphalian (see explanatory map, in which the main and lesser cotton-manufacturing towns are indicated by ringed and solid dots, respectively).

The first section lies north of the mountains of northern Bohemia, and consists of the Kingdom of Saxony and the Upper Franconia Province of Bavaria. In regard to general cotton manufacturing, including not only spinning and weaving, but knitting, embroidering, lace making, cotton-waste manufacture, artificial flowers, etc., it is the most important section of Germany. It contains some 3,000,000 spindles, and its most important towns are Hof, Baireuth, and Bamberg, in Upper Franconia, and Chemnitz, Mittweida, Plauen, Plaue, Werdau, Crimmitschau, Zittau, and Zwickau, in Saxony. The second section lies in the extreme southwest corner of Germany, between the cotton-manufacturing districts of East France, Switzerland, and the Austrian Vorarlberg, and contains some 4,000,000 spindles, unequally distributed between Alsace, Baden, Wurttemberg, and Bavarian Swabia. The main cotton-manufacturing towns are Mulhausen, Gebweiler, and Logelbach, in Alsace; Augsburg and Kempten, in Bavaria; Unterhausen in Wurttemberg; and Lorrach in Baden.

The third section lies in the northwest corners of the Prussian Rhine and Westphalian provinces, and has 2,500,000 spindles. The main centers are Gronau, Rheine, Bocholt, and Epe, in Westphalia, and Rheydt, Munchen-Gladbach and Mulfort, in the Rhine Province.

There are in Germany 21 towns having more than 100,000 spindles each, and these 21 towns united have more than half the spindles in Germany. These towns, with the number of spindles and looms in each, are as follows:

Towns.	Spindles.	Looms.	Towns.	Spindles.	Looms.
Mulhausen	520,300	8,797	Chemnitz	165,900	1,897
Augsburg	509,676	9,630	Mittweida	162,000	1,761
Gronau	494,234	1,055	Logelbach	146,908	3,253
Rheine	406,728	5,175	Crimmitschau	142,560	----------
Rheydt	345,113	4,421	Baireuth	141,032	758
Hof	325,136	3,169	Bamberg	125,000	2,186
Werdau	304,000	----------	Falkenau	107,000	----------
Munchen-Gladbach	273,478	8,493	Kempten	106,808	2,489
Gebweiler	210,132	2,027	Plaue	105,000	----------
Leipzig	206,000	----------	Mulfort	100,446	----------
Bocholt	197,220	7,838			

The weaving industry is more scattered, and there are more than 50 towns with more than 1,000 looms each.

LEADING MILL TOWNS.

Mulhausen in Alsace is the most important town in Germany as regards spindles and looms. Nowhere in Germany is the cotton industry better organized than at Mulhausen, and this place has become noted for its fine muslins and print goods. One of the main products of this place is a fine cotton print known locally as a 75/26 print, but which we would call a 24/26 print—that is, with 24 warp and 26 filling ends per ¼ inch. These are made 31 to 32 inches wide, and some of them are exported to the United States. Having a large local trade, Mulhausen is not a great export center, though it ships some fine bleached goods and fine prints to the neighboring sections of France and supplies muslin for St. Gall embroiderers. Mills are scattered throughout the country around Mulhausen. These mills do not build the ugly tenements as seen everywhere in Saxony, but house their help in cottages containing each one or two families. The operatives enjoy more privacy and have more real home life than is seen in most textile sections of Germany. Frequently only one or two of the family work in the mill, while the others tend a farm. Besides Mulhausen, the other two large textile centers of Alsace are Gebweiler and Logelbach, though there are a score or more of smaller towns of more or less importance clustered in this vicinity.

Next to Mulhausen the largest cotton mill town is Augsburg, in the province of Swabia, in Bavaria. This is one of the important towns of South Germany. It has about 95,000 people, and lies at the junction of the Wertach and Lech rivers, 38 miles northwest of Munich. Contrary to the custom of Mulhausen, where practically no water power is used, the Augsburg mills are run mainly by water power. Canals traverse the town and the mills are situated on these canals on the outskirts of the town. A manufacturer estimates that Mulhausen spins average No. 36s, and Augsburg average No. 26s.

Gronau, in Westphalia, has only six mills and is a little village of only 8,500 inhabitants, but is the third largest cotton-mill town in

Germany. This is mainly due to the fact that the largest cotton-spinning mill is located at this point.

One of the densest cotton-mill centers is that made by the three close neighbors, Rheydt, Munchen-Gladbach, and Mulfort, in the Rhine Province. These three towns, of 40,000, 60,000, and 8,000 inhabitants, respectively, have together 719,037 spinning spindles, 75,000 twister spindles, and 12,914 looms.

SPECIALIZING CENTERS—GENERAL STATISTICS.

Chemnitz stands twelfth in number of spindles, but is one of the most important cotton manufacturing towns in Germany. Its importance is due to the fact that it is the center of the German knit goods manufacture. Plauen is a town with no spinning and few looms, but is also an important cotton-manufacturing center, owing to its etched lace and embroidery work. Very little machine-made lace is made in Germany, but the largest factory of this kind is at Dresden. Except for this, and for the manufacture of artificial flowers, Dresden is not important as a cotton manufacturing center. Werdau and Crimmitzschau, in western Saxony, are important as being the center of the large vigogne yarn spinning business. Barmen, in the Rhine Province, is noted for its braided work and for its manufactures on the ribbon loom. Crefeld is noted for its velvet manufacture and velvet dyeing; Elberfeld for its dyeing; Munchen-Gladbach for its colored goods, etc.

Comparatively few of the German mills have both spindles and looms, and in the big centers the mills specialize on either spinning or weaving, as is the custom in England. The more remote mills in the country sections of Alsace and the Rhine usually weave their own yarns.

CONDITION OF THE INDUSTRY.

The following table shows the status of the German cotton manufacturing industry at the end of 1905, giving the details of the industry in each State:

States.	Spinning mills.	Spinning and weaving mills.	Weaving mills.	Spindles.	Twister spindles.	Looms.	Bales of cotton consumed.
Saxony [a]	96	7	54	1,968,580	89,824	39,236	388,085
Bavaria	16	13	53	1,577,632	38,686	31,092	300,000
Alsace	16	32	43	1,536,562	16,550	39,919	240,000
Westphalia	17	18	36	1,456,636	47,892	25,729	255,300
Rhine Province	42	24	121	1,275,355	110,454	24,408	287,090
Wurttemberg	11	17	48	761,440	6,380	19,352	115,000
Baden	10	13	28	526,804	16,580	16,744	80,134
Hanover	1	7	18	225,000	17,400	5,024	48,425
Sflesia	9	5	45	133,930	1,250	16,540	28,315
All others	7	6	47	268,270	25,600	13,155	19,020
Total	225	142	493	9,730,209	370,616	231,199	1,761,369

[a] Includes 60 mills on vigogne spinning with 608,950 spindles.

This table shows that Saxony has practically no mills that combine both spinning and weaving, while Alsace has the largest number of these. By dividing 9,730,209 spindles by 367 spinning mills and 231,199 looms by 635 spinning and weaving and weaving mills it is apparent that the average spinning mill in Germany has 26,500 spindles and the average weaving mill 364 looms. Bavaria, with an average of 54,400 spindles to the mill, is seen to have mostly large mills,

while the Rhine Province, with only an average of 19,300 spindles, is seen to have a great number of small mills. The Bavarian weaving mills average twice the size of weaving mills on the Rhine.

The foregoing table does not correspond exactly as to the number of spindles with that previously given by the Bremen Cotton Bourse, but was made up at the end of the year 1905 by W. Rieger, of Stuttgart, and this is the latest complete table that can be found in Germany in regard to cotton-mill statistics. There has not been a table made up by anyone since 1905, though the president of the German section of the International Federation of Master Cotton Spinners and Manufacturers' Association estimates that on March 1, 1908, there were in Germany 9,592,855 spindles in operation, and 455,946 being installed, or a total of 10,048,801. He furnished me with a table showing that the 9,191,940 spindles estimated by him as being in operation on August 31, 1907, had consumed during the previous twelve months the following number of bales of cotton from the several countries, counting 2 round bales of American as equal to 1 square bale: American, 1,135,538; Indian, 380,367; Egyptian, 98,615; all other, 46,660; total, 1,661,180.

REPRESENTATIVE MILLS AND THEIR EMPLOYEES.

Both spindles and cotton consumption as estimated by this association are lower than the detailed figures showing the number of mills and the spindles of each that were compiled by Mr. Rieger in 1905, and since for the calendar year 1907 there were used in Germany—as shown by the imports less the reexports—933,938,168 pounds of cotton, net weight, as compared with 812,050,576 pounds in 1905, or 15 per cent more, it is probable that the estimated figures of the association are too small.

The German department of the interior informed me that they had no recent figures, and that those of W. Rieger, of Stuttgart, for 1905 were the most recent that they knew of.

There are twelve cotton mills in Germany with over 100,000 spindles each, and two of these have each over 200,000 spindles; five mills have more than 2,000 looms each, and 35 have more than 1,000 looms each. The following are the largest German cotton mills:

Company.	Town.	Province.	Spindles.	Looms.
Gerritt van Delden & Co	Gronau	Westphalia	220,000	
Leipsiger Baumwoll-Spinnerei	Leipzig	Saxony	206,000	
Baumwollspinnerei am Stadbach	Augsburg	Bavaria	148,316	
Vogtlandische Baumwollspinnerei	Hof	do	144,780	
Kullman & Cie	Mulhausen	Alsace	143,000	1,700
Chemnitzer Aktien-Spinnerei	Chemnitz	Saxony	142,000	
Mittweida Baumwollspinnerei	Mittweida	do	140,000	
Mechanische Baumwoll-Spinnerei und Weberei.	Augsburg	Bavaria	126,940	2,920
Do	Bamberg	do	125,000	2,000
Georg Lieberman	Falkenau	Saxony	107,500	
E. J. Claiss Nachfolger	Plaue	do	105,000	
C. Kümpers Söhne	Rheine	Westphalia	105,000	1,400
Hartman & fils	Munster	Alsace	51,200	2,460
Ulrich Gminder	Reutligen	Wurttemberg	92,330	2,084
Herzof Etablissements	Logelbach	Alsace	85,000	2,000

The most important cotton mill in Germany, also the best paying, as shown by its published dividends, is the Augsburg Mechanische Baumwoll Spinnerei und Weberei at Augsburg, in Bavaria. This mill has 126,940 spindles running on average No. 17s English, and

2,920 looms, of which 520 are on bleached goods, especially printers, and 2,400 on heavy gray goods. It employs some 3,000 operatives, and its annual pay roll amounts to about $450,000. Water power is used, with supplementary steam power. It uses nearly 30,000 bales of cotton and produces some 12,000,000 pounds of yarn and 30,000,000 yards of cloth yearly. The mill was founded in 1837, and its capital stock is now 3,600,000 marks ($856,800), while its 4 per cent bonded indebtedness is 500,000 marks ($119,000). The mill has a large reserve fund, and a special sinking fund, and has 200,000 marks ($57,600) reserved for the pension and relief of employees. The dividends distributed by this mill to its stockholders for the seven years ended with 1906 were, in consecutive order, 20.4, 14.6, 16, 23.5, 17.5, 23.5, and 28 per cent, or 143.5 per cent in the seven years.

THE LABOR QUESTION.

Heating and ventilation in this mill is carried on by means of flues built in the wall, the air going up the flues on one side and being drawn down to the basement again through the flues on the other side. Separate dressing rooms with clothes lockers are provided for the men and women on each floor. There is also provided a large hall with tables and chairs where the operatives can eat their lunches. Coffee and milk is sold in the morning, hot soup at noon, and beer at 4 o'clock. A demi-liter (about a pint) of coffee with milk is sold at 7 pfennigs (1.67 cents); a portion of soup with vegetables and, occasionally, with meat, is sold for 30 pfennigs (7.14 cents), and beer sells for 20 pfennigs (4.8 cents) a liter (1.05 quarts). This is almost cost price, and any profit over expenses goes to the workers' pension fund. Operatives are lodged partly in tenement houses and partly in cottages. A lodging of three rooms and a kitchen rents for 100 to 140 marks ($23.80 to $33.32) a year. Until 1906 this mill ran an 11-hour day, but it then changed to 10 hours.

This 9.1 per cent decrease in time was allowed by a 7.85 per cent decrease in production. In regard to wages at this mill, the picker room hands and the carders get 50 to 70 cents a day; on two 900 self-actor mules the spinner averages about 90 cents a day, the piecer 71 cents, and each of the two creelers 35 cents a day. Weavers, on an average, run three looms apiece, and make about 80 cents a day; 170 of the looms have the Northrop attachment. At this mill a man is supposed to serve a two-years' apprenticeship before he can do as simple work as that of running three looms on plain goods. He has to sign a two-years' contract to this effect. He first works as extra assistant to a weaver for six months, then he is given one loom, which is run under the supervision of the regular weaver, who receives a certain percentage on the wages made. Then he is given two looms under the same conditions, and it is not until the new weaver has been working for two years that he is considered a full-fledged weaver and allowed to enjoy the fruits of his labor without division. During the first six months the mill usually pays the apprentice 24 cents a day.

DOUBTFUL RESULT OF THE APPRENTICESHIP SYSTEM.

After all this elaborate apprenticeship system it is doubtful if the weaver is as good as the young American weaver who comes in from the farm and in a few months at most is getting off the required production along with the others. All fines and pen-

[From Consul C. B. Hurst, Plauen.

INTERIOR OF A SAXON HOME, SHOWING AN OLD-FASHIONED HAND LOOM.

alties are paid to a sick fund. Besides the regular Government insurance, this mill has special insurance funds of its own for the relief of the sick, for old age and invalid pensions, for the relief of widows, etc.

The pension fund of this mill provides a pension after 20 years of service equal to 30 per cent of the annual wages; this is augmented 2 per cent every year up to 40 years service when it is 70 per cent. It is then augmented 3 per cent per year up to 50 years when the worker is entitled to a pension equal to his regular wages. Except in special cases a worker is not accorded a pension until he has reached the age of 50 years.

By means of the two years' apprentice contract for weavers, and by means of the old age and other pensions for long service, this mill offers all inducements possible to insure the worker remaining at home. The German operatives do not roam about from mill to mill as is so much the custom in the United States, and therefore the mills are enabled to keep their processes more secret, and little improvements made at one mill are not so soon caught up and made general among other mills. According to law, the mill is supposed to pay one-third of the yearly premiums on the workers insurance, the workers paying the other two-thirds, but this mill voluntarily pays two-thirds, as do a good many other mills, only leaving one-third to be paid in to the Government by the operatives.

LARGEST SPINNING MILLS.

While the foregoing is the most important cotton mill in Germany it does not have the largest number of spindles, the first place in this respect being held by the mill of Gerritt van Delden & Co., with 220,000 spindles, located near the Holland border, in Westphalia, at the little village of Gronau.

The mill with the next largest number of spindles is the Leipziger Baumwoll-Spinnerei, at Leipzig-Lindenau, in northern Saxony. This mill makes a specialty of combed and carded Egyptian yarns of all numbers, from 10s to 120s. The annual consumption is some 28.000 bales of cotton. The capital is 3,000,000 marks ($714,000). Besides regular and special reserve funds there is a fund for the pension and relief of workmen amounting to 110,000 marks ($26,180). The dividends paid by this mill in the six years ended with 1906, were consecutively 12.5, 12.5, 12.5, 14, 16, and 16 per cent, or a total of 97.5 per cent. Each operative commencing work at this mill is given a copy of the mill rules and regulations and has to agree to abide by these by signing his name in a special register. About a third of the employees belong to unions. This mill employs quite a number of Poles and Bohemians. At the mill dining hall there is sold every morning before work commences coffee, milk, and cocoa, to induce the workmen to refrain from taking a morning dram of spirits. Bathing at least once every two weeks is obligatory at this mill. On the envelope containing his fortnight's wages each workman finds a card indicating the day and hour that he is to report at the bath house. Sick insurance calls for 3½ per cent of the wages, but the workman pays 2⅓ per cent of this, and the factory 1⅙ per cent. Where this sum does not cover the expenditures, as often happens, the factory voluntarily makes up the deficit without calling on the workers.

A PROSPEROUS YEAR—PRIVATE AND STOCK COMPANIES.

In regard to the dividends paid by the two foregoing mills it should be stated that these are not to be taken as averages for German mills. A list that was published of the results of 40 leading German cotton mills shows that in 1906, 5 out of the 40 declared over 20 per cent dividends, 17 others paid over 10 per cent, 15 paid between 4 and 10 per cent, and two lost money. This was an exceptionally prosperous year.

The bulk of the German cotton mills are private companies. The most recent figures show that of the spinning mills some 75 per cent are private companies, also 66 per cent of the combined spinning and weaving mills and 98 per cent of the weaving mills. Bavaria, which has the largest mills, also has the largest percentage of incorporated stock companies—in fact, the majority of the Bavarian spinning mills are stock companies. In Westphalia, on the Rhine, and in Saxony nearly all mills are private companies. The weaving mills in Bavaria as well as elsewhere are practically all private companies.

Of the 231,199 looms in Germany in 1905 it was estimated that about 40 per cent were on colored goods, 30 on heavy gray goods, 20 per cent on calico and similar goods, and 10 per cent on fine goods. Goods are made from the finest yarns most largely in Alsace, then in Saxony, and then Bavaria.

RESULTS OF THE SHORTER WORKDAY.

As it is frequently claimed that the shorter the working day the more intense is the work, it is interesting to see what result was obtained in Bavarian cotton mills by the reduction on January 1, 1906, of the working hours from eleven to ten. The following statistics have been published showing the decreased consumption of cotton and the decreased production at seven of the leading mills of Augsburg:

Mills.	1905.	1906.	Percentage decrease.
Mechanische Baumwoll-Spinnerei und -Weberei:			
Cotton consumed ..... bales..	28,447	26,792	5.82
127,000 spindles on No. 17, yarn produced ..... kilos..	5,381,000	4,957,400	7.85
Baumwoll-Spinnerei am Stadtbach:			
Cotton consumed ..... bales..	26,213	24,011	8.40
147,000 spindles on No. 23¼, yarn produced ..... kilos..	5,165,000	4,866,600	5.78
Haunstetter Spinnerei und Weberei:			
Cotton consumed ..... bales..	4,773	4,590	3.84
39,000 spindles on No. 31¼, yarn produced ..... kilos..	927,000	871,200	6.01
Mechanische Baumwoll-Spinnerei und Weberei:			
Pieces produced ..... number..	445,670	423,960	4.87
3,000 looms, cloth produced ..... meters..	28,670,000	27,100,000	5.48
Haunstetter Spinnerei und Weberei:			
Pieces produced ..... number..	185,310	175,440	5.34
960 looms, cloth produced ..... meters..	11,537,000	10,955,000	5.07
Mechanische Weberei am Fichtelbach:			
Yarn worked ..... kilos..	1,120,000	1,042,100	6.95
1,210 looms, cloth produced ..... meters..	12,362,400	11,718,200	5.22
Baumwoll-Weberei Zöschlingsweiler:			
Yarn worked ..... kilos..	1,087,617	1,007,400	7.37
970 looms, pieces produced ..... number..	183,000	175,870	3.88

This shows that in these mills a decrease of the working hours from 11 to 10 or 9.09 per cent resulted in a decrease in the consumption of cotton of 6.02 per cent, a decrease in the production of yarn of 6.54 per cent, and a decrease in the production of cloth of 4.92 per cent.

[From Consul C. B. Hurst, Plauen.

ONE OF THE MANY SAXON WEAVING MILLS.

COTTON MILLS.

COST OF BUILDING A COTTON MILL—VARIOUS MATTERS INCIDENTAL TO FACTORY MANAGEMENT.

If the total number of spindles in Germany be divided by the total number of mills containing spindles, the average number of spindles per mill is 26,500. Data are furnished herewith in regard to the cost of building and operating a mill of 30,000 spindles. A concern at Mulhausen in Alsace has a capital of 18,000,000 francs ($3,474,000), and is the only firm in Germany that makes a complete line of cotton-mill machinery and that contracts to build and equip cotton mills ready for operation. This company is therefore the best authority on the cost of such mills. Its president furnishes the following data:

For a cotton mill of 30,000 spindles to spin warp yarns of say 27/29 French counts (equal to 32/34 English counts), and filling yarns of say 36/38 French counts (equal to 42/45 English counts), the cost of construction, without the ground itself, will range between 50 and 60 marks ($11.90 to $14.28) per spindle, complete. The cost will vary between these two extremes according to the outlay considered necessary for the house of the manager, the storehouses, and the accessories. Taking the average of 55 marks ($13.09) per spindle this amount will ordinarily be made up as follows:

Description.	Cost.	
	Marks.	*Dollars.*
Spinning machinery proper	25	5.95
Spinning accessories, cans, belting, etc	5	1.19
Steam engine, lighting and heating equipment	9	2.142
Building and sheds	12	2.856
Miscellaneous expenses	4	.952
Total	55	13.09

For a weaving mill of 500 looms the expense will be about 1,000 marks (mark=23.8 cents) per loom, viz:

Description.	Cost.	
	Marks.	*Dollars.*
Looms	400	95.20
Preparatory and sizing machinery, etc	50	11.90
Steam plant, lighting and heating	250	59.50
Building	200	47.60
Miscellaneous expenses	100	23.80
Total	1,000	238.00

In the foregoing figures the cost of the land is omitted as being too variable a factor to average, but for the ordinary German cotton mill located just outside of a town this might be estimated at 5 marks a square meter ($1.19 per 10.76 square feet).

NUMBER AND APPORTIONMENT OF OPERATIVES.

The wages paid in cotton mills in different parts of Germany vary, as also does the number of operatives required for a given number of machines or for a given production. For mills on similar goods and similarly located wages are lowest in Saxony and highest in Rhine. The mills around Augsburg seem to afford a fair average for the German industry as a whole. For a 30,000 spindle mill there is required under average conditions the following workers:

For general oversight: One obermeister (superintendent); one vorarbeiter (foreman) in the opening and mixing room; one meister and one untermeister (boss grader and second hand) in the card room; one spinnmeister (boss spinner) for every 10,000 to 15,000 mule spindles, and one throstlemeister (boss spinner) for every 10,000 to 15,000 ring spindles.

Mixing room: One man for every 6 bales daily, and one girl for every 12 bales daily, to pick and bundle the bagging and do similar light work.

Picker room: One man to every two openers, one man to every two pickers or lappers, one man for the waste machine, and one lap carrier for every 12 bales daily.

Cards: One card grinder to every 24 cards, one operative to every 8 cards, and one can girl to every 16 cards, the cards making 165 pounds in ten hours.

Draw frames: One girl to 16 deliveries for fine slivers, to make No. 30s and above, and one girl and an assistant for coarse numbers.

Fly frames: One operative to every 80 slubber spindles; one operative to 120 intermediate spindles on hank rove under No. 1.4—above this number there is required one helper to every two frames; one operative to every 144 spindle fine frame under 3⅓ hank roving, with the addition of one helper for every two frames making over No. 4 hank roving.

Mule spinning: For every two mules containing 1,800 to 2,000 spindles one spinner, two piecers, and two creelers, if on numbers under 20s; for finer numbers for a similar number of spindles one spinner, one piecer, and one to two creelers.

Ring spinning: One girl spinner to every 300 to 400 spindle warp frame on No. 20s; one girl for every 380 spindle frame on filling, with one young assistant for every two frames; for every two spinning frames one girl doffer.

There is required one engineer and one assistant in the engine room, one dynamo tender and one transmission tender and machinist, one fireman and one coal passer for every 200 horsepower, one head machinist and two assistants, one wood turner and carpenter, one gate keeper, etc.

The operatives per 1,000 spindles average between 6 and 8.

FUEL USED BY GERMAN COTTON MILLS.

The German cotton mills are mainly steam plants. Some of the mills in Bavaria and Baden, near Switzerland, including most of the mills at Augsburg, use water power, and a few in upper Franconia are operated either wholly or in part by water power, but with these exceptions the bulk of the mills are operated by steam. There are 97 square miles of lakes in the 29,000 square miles of Bavaria

and the length of the rivers included in this Kingdom is 44,285 miles. In the highlands of Bavaria there is abundant water power available, estimated at over 300,000 horsepower, but this is as yet little utilized. It is expected that the State will acquire the legal right to expropriate vested rights in the more important rivers and streams and will develop the water power for commercial purposes. Electricity is beginning to be largely used in mills; at Plauen, for instance, every lace factory in the town is operated by current obtained from the city power house.

Germany produces a considerable part of the fuel that it consumes and also exports about 10 per cent of its production to neighboring countries. Lignite is largely used in the form of briquettes.

Germany produces about 15 per cent of the coal output of the world, and is the largest single producer after the United States and the United Kingdom. The German production in 1907 was as follows, in metric tons (2,204.6 pounds): Stone coal, 143,222,886; brown coal, 62,319,802; coke, 21,938,038; brown coal briquettes, 12,890,461; black coal briquettes (pressed lumps), 3,524,017; total, 243,895,204.

The main coal basins for Germany are found at Ruhr in the Rhine province, in Upper and Lower Silesia, and at Bonn in the Rhine province. These three centers produce 55, 25, and 12 per cent, respectively, of the total; the remainder coming from Zwickau-Oelsnitz in Saxony, Zweibrucken in the Palatinate, Munich, Dresden, and Bayreuth.

The lignite is produced mainly at Halle, in the province of Saxony, and at Bonn, in the Rhine province, these two places producing 66 and 14 per cent, respectively, of the total, the remainder being obtained from Saxe-Altenburg, in Anhalt; Leipzig and Dresden, in Saxony; Braunschweig, Silesia, Magdeburg, and Hesse.

MILLS LOCATED NEAR FUEL SUPPLY—WHERE COTTON IS OBTAINED.

The old mills were located for water power, while the new are located with regard to the nearness of a fuel supply and for transportation facilities. The coal mines of the Rhine region have had a great deal to do with the increase of cotton manufacturing in the Rhine and Westphalian provinces, and similarly the coal mines in Saxony and Silesia have been of great advantage to the cotton and other manufacturing industries of those sections.

Cotton is obtained by the German cotton mills through cotton brokers at Bremen and Hamburg, with smaller amounts through the ports of the Low Countries and Dantzig. Bremen is by far the largest cotton import center on the Continent, and ships cotton not only to all parts of Germany and to Austria and Switzerland, but as far inland as Moscow and northern Italy. It seems strange that any cotton should be imported by Italian mills from Germany, but it is due to the fact that Bremen is the largest import center, and always has cotton on hand ready for shipment as desired, and that there are many brokers from which to order, while there are few cotton brokers at Genoa, and in the entries at that port there is frequently serious delay, owing to the congestion of the insufficient railway accommodations inland. During 1907 nearly 250,000 bales of cotton, valued at over $14,000,000, were supplied by German brokers to neighboring nations. There are large cotton storage warehouses at Bremen and the storage rate is low, so that many mills in different parts of Germany keep their purchases stored here and have monthly shipments made as

needed, while the smaller mills buy in weekly or monthly lots from the brokers as desired. The brokerage charged is one-half of 1 per cent, paid in equal proportions by the buyer and seller. American cotton is imported on c. i. f. terms, 6 per cent, sixty days with 1 per cent weight allowance. Cotton is sold at Bremen for spot or future delivery, but there is no dealing in "futures" at Bremen and but little at Hamburg.

INLAND AND EXPORT FREIGHT RATES.

The inland freight rates on cotton from Bremen and Bremerhaven to the main cotton manufacturing centers of Germany and Austria are as follows per 100 pounds:

From—		To—	From—		To—
Bremen.	Bremerhaven.		Bremen.	Bremerhaven.	
Cents.	*Cents.*		*Cents.*	*Cents.*	
8.64	10.04	Munchen-Gladbach.	22.79	24.08	Augsburg.
16.52	18.58	Chemnitz.	26.82	27.97	Prague.
20.41	21.81	Mulhausen.	36.93	39.10	Vienna.

The following are the rates now (April, 1908) being paid by German cotton piece-goods exporters to the various countries of the world on piece goods exported from Bremen:

Destination and basis.	Rate.	Deviation from rate.
New York [a] per 35.316 cubic feet	$5.00	
Rio de Janeiro do	13.09	10 per cent rebate.
Montevideo do	9.52	Do.
Buenos Aires do	9.52	Do.
Valparaiso do	14.28	Do.
Mollendo do	14.28	Do.
Yokohama do	10.115	5 per cent rebate.
Hongkong do	10.115	Do.
Shanghai do	10.71	Do.
Singapore do	8.925	
Rangoon per 40 cubic feet	8.52	Plus 5 per cent primage.
Calcutta do	4.866	Do.
Bombay do	4.866	Do.
Alexandria per metric ton	9.733	Plus 10 per cent primage.
Smyrna do	9.733	Do.
Constantinople do	9.733	Do.
Athens do	9.733	Do.
Beirut do	10.95	Do.
Naples per 35.316 cubic feet	3.57	

[a] These rates are by mail steamers; by fast steamers the rates are $7.50.

TEXTILE PRINTING PRICES.

Mulhausen, in Alsace-Lorraine, is noted for its fine prints. I obtained while there the prices charged by three separate establishments for printing. These were as follows, per meter (1.09 yards):

Description.	Establishment A.	Establishment B.	Establishment C.
Cotton:	*Cents.*	*Cents.*	*Cents.*
32-inch goods, 1 and 2 rollers	3.11	3.97 to 4.46	3.85
56-inch goods, 1 and 2 rollers	5.60	5.97	6.47
32-inch goods, 1 and 2 rollers, using heavy colors with ground	3.32	5.52 to 6.22	4.10
Mousseline de laine, 30-inch:			
1 roller	3.85	4.72	5.47
1 roller, with heavy colors and ground	4.35	5.97	7.73 to 6.22
2 to 8 rollers	4.97 to 8.45	5.47 to 11.90	5.72 to 10.45
9 to 12 rollers	9.45 to 11.19	10.45 to 11.94	9.95 to 11.44

The rollers are furnished by the printer, the engraving design by the merchant with his cloth. The charges include the necessary bleaching before printing and the finishing and folding up after printing. Damaged pieces are charged half price.

It is interesting to note that very often German cotton piece goods, say prints, can be bought cheaper in foreign countries than at the price they are being retailed for in Germany.

RULES REGULATING WORK IN A GERMAN COTTON MILL.

The rules that are posted up in every German factory, according to the requirements of the law, throw a good deal of light on the methods of work in the different sections. The following are the rules of one big German cotton mill, and are taken from a recent publication by a French authority, who wrote a report on German factories, but are similar to rules I have seen in factories in Saxony and Westphalia:

1. Every worker on his admission to the factory receives a copy of these regulations and must sign a declaration showing that he has received this copy and accepts the conditions as a contract of work according to the provisions of the law.

2. Anyone desiring to obtain work at the factory must first show a quittance from the invalidity insurance fund and the certificate of dismissal from the last establishment at which he worked (minors must show their record book). He must be examined by a doctor and the admission is temporary only for two weeks. At the expiration of two weeks and on a certificate from the doctor showing his state of health he may then be accepted by the management, and is enrolled as a member of the sick fund. In the case of apprentices their fathers or guardians must sign the contract.

HOURS OF WORK—CONDUCT OF EMPLOYEES.

3. The regular hours of work are from 6 in the morning to midday and from 1 o'clock to 6 in the evening; on Saturdays and the eves of holidays to 5 in the evening. Women who have households to manage may on demand quit at 11.30 o'clock in the morning. The hours of work and the rests allowed minors are shown by paragraphs hung on the walls of the workroom. Adults are not entitled to these rests. The commencement and the end of work hours are announced by signal.

4. On Sundays and legal holidays the factory does not run. Adult employees may be held to perform, after the cessation of work and on Sundays and holidays, such special work as is authorized by law.

5. It is forbidden to enter or leave the factory by other than the regular entrances. The gates are opened fifteen minutes before the commencement of work. It is forbidden for women and children to commence any work before starting time. Those tardy and those leaving before the stoppage of the machines are punished by fine. Leaving during the hours of work is not allowed except by the authorization of the superintendent and this authorization carried to the gate keeper.

6. Obedience is due to superiors and the work prescribed must be executed with good will. It is forbidden to make a noise in the halls or to assault a fellow worker. When a worker presents himself at the mill in an intoxicated condition he loses his work and salary for that day; on a repetition of the offense he is discharged. No worker has the right to enter rooms other than that in which he works. During the midday rest and after work no worker has the right, unless by special authorization, to remain in the factory. Machines and appliances used by a workman must be kept in good order. Modifications or repairs must only be made by the foremen or on their direct orders. It is forbidden to introduce strangers into the factory.

PRECAUTIONS AGAINST ACCIDENTS—CARE OF PROPERTY.

7. The rules shown on the wall as to precautions to be taken to avoid accident must be followed strictly for the interest of the worker. It is strictly forbidden to clean machinery or shafting while in motion. Each worker is

book to certify by his signature that he will take notice of these precautions to avoid accidents.

8. Workers must take care of all material delivered to them and must gather up and deposit waste made in the places provided. It is forbidden to take away any object, however valueless, waste or anything else, and workers must allow themselves to be examined if such is found to occur. Offenses will be submitted to the courts. To throw cotton, waste, etc., in the cabinets or on the street will be considered as damage within the meaning of the law of work.

9. Water-closets and their surroundings must be left in good order. Clothes and baskets brought to the factory must be kept in their proper places. It is forbidden to smoke in the factory or the courtyards, and it is forbidden to carry matches in the pockets within the factory. Pipes, lanterns, and matches must be left with the gate keeper, who will take care of them. Everyone must observe these precautions carefully to avoid danger of fire, and any disregard of these rules entails the immediate exclusion of the offender without appeal.

10. Food and drink must not be introduced into the workrooms except at the prescribed hours—that is, from 8 to 8.30 o'clock in the morning and from 3.30 to 4 o'clock in the afternoon. It is absolutely forbidden to bring brandy into the factory. Any traffic or collecting, etc., is absolutely forbidden, and after one warning results in dismissal.

PAYMENT OF WAGES AND FINES—QUIT NOTICES.

11. Wages paid are determined according to the tariffs shown on the walls. Weavers are paid per cut. The fines levied for deterioration of merchandise or damage to other objects through the negligence or by the fault of the worker are deducted from their pay and given to the sick fund.

12. Accounts are made up every fortnight on Saturday evening and are paid the next Saturday, with the deductions authorized by law. The worker must verify his wages and make any claim immediately, for later claims will not be allowed, so as to avoid the mixing of strangers into matters concerning the wages of employees.

13. In case the factory is not able to run and the management has thereby to refuse work to the operative, the factory can not be held liable for damages, such stoppage being due to accident to the motors or similar cause. As far as the law permits such time will be made up by extra work overtime.

14. The operative can not claim payment for hours that he did not work, even though it was not due to his fault.

15. Two weeks' notice of termination of contract may be given by either employer or employee, but such notice must be given on Saturday, when the accounts are made up, at the office between 4 and 5 o'clock in the afternoon. The notice will be better if signed by a superior and given to the worker at the hour named, or given by the worker to the office, as the case may be. Quitting work at the factory without due notice or valid excuse is held to be a breach of contract, and in accordance with the law of work there will be retained a week's wages to be turned over to the sick fund, and a civil action may also be instituted in the courts if considered advisable. Besides the provisions of the law of work, disregard of the regulations for avoiding accidents entails immediate discharge without notice.

PUNISHMENT FOR OFFENSES—EMPLOYEES' PENSION FUND.

16. Offenses committed under the present regulations or under the provisions of the law of work may be punished by fines. Separate fines can not exceed half a day's wages, except that acts of violence against his inferiors or fellow-workmen, rudeness toward his superiors, grave impropriety, and offenses against order may be punished by a fine equal to a day's wages. Usually for the less serious cases the offender is first only warned, on repetition he is fined. The obligation to pay fines levied is not annulled by the fact of giving notice. All fines deducted from the wages go to the sick fund.

17. All fines and deductions are fixed by the foreman of each room and notification given to the worker. He has the right to appeal to the superintendent, who finally decides.

18. Any worker can be admitted to the pension fund founded for the benefit of the operatives after five years of service if there is no opposition to his admission. The premiums for this fund are paid by the factory at their own cost without any deduction from wages. Payments may be made to a savings

fund, which pays 4½ per cent interest. Deposits may be made of from 1 to 30 marks (23.8 cents to $7.14) a week. When an account reaches over 1,000 marks ($238) the rate of interest is decreased or the total deposit is returned.

19. These regulations, drawn so as to conform to the law, after having been brought to the attention of the regular workers' committee of the sick fund, were submitted to the higher authorities, approved by them, and will be enforced strictly.

GOVERNMENT REGULATIONS.

In Germany there is no law limiting the hours that may be worked by men, but there are numerous detailed provisions in regard to the employment of women or children, the conditions of employment, holidays, payment of wages and fines, protection from accidents, etc. The general law was passed July 26, 1900, and stricter provisions added December 16, 1907. The following extracts from the law are reproduced to show under what legal conditions German cotton mills operate:

Contracts may be freely made between employers and employees, and these contracts are legal unless they violate some provision of the law. The operative is not compelled to work on Sundays or holidays, and factories are forbidden to run on such days. Holidays are fixed by the authorities of each province according to the local customs, but the Government prescribes at least forty-eight hours each for Christmas, Passover, and Pentecost. New Year's Day, Easter Monday, Ascension Day, Whit Monday, and Repentance Day (middle of November), are usually given, and in some sections many more, including dates connected with the birth and the accession of the ruler. Operatives may be employed on Sundays and holidays at the works where specially permitted by the authorities. These special cases include urgent work in the public interests, to take inventories prescribed by law, for repair and maintenance work difficult to effect during the week, for work impossible to effect during the week and the nonexecution of which would injure the goods, and for the inspection of the work done during the week.

EMPLOYEES' RECORD BOOKS AND CERTIFICATES.

Each worker under age must have a record book, in which is given his name, date and place of birth, the name and residence of his legal representative, and the signature of the worker. This book is signed and stamped by the authorities and is retained by the employer until the expiration of the contract made by the worker, when it must be returned to him. When the worker enters the factory the employer must write in ink the date and the nature of the employment, and when the employee quits the employer must write the date; also any change of class of work in the meantime and the last class of work performed. Observations advantageous or disadvantageous to the worker are forbiddden.

On his departure a worker may demand a certificate relative to the duration and nature of his work. If the worker demands it, the certificate must also mention his conduct and his services. It is forbidden for the employer to draw attention to the worker by adverse remarks or by marks made on the certificate or to give in regard to the worker any other report than that given in the text of the certificate.

PAYMENT OF WAGES AND FINES—COMPLEMENTARY INSTRUCTION.

Wages must be paid in currency or legal tender, and must not be paid on Sundays. It is forbidden to furnish merchandise on credit in lieu of wages with the exception that food and combustibles may be furnished at net cost and lodgings furnished at the customary local rents and payments for these deducted from the wages due. Workers' wages can be retained as indemnity for damages caused by an infraction of the contract, but must not exceed more than one week's wages at the fortnightly settlement, except in case of acts against fellow-workmen, of offenses against morality, or against regulations for the maintenance of order and security, and for the fulfillment of statutory provisions. In these cases fines may be imposed to the full extent of

the wages due. All fines must be applied to the benefit of the factory workers and usually go to the sick fund, but this does not affect the right of the employer to obtain legal compensation for damage. Particulars of all fines must be entered by the employer in a book, which is open to inspection by a Government officer.

Where there are any workers under 18 years of age liable according to the law to attend a complementary course of instruction at schools under the care of the State or the community the employer is obliged to grant such young workers the time necessary for this study and the time required is fixed by the administration. This includes also complementary instruction to females by lessons on sewing and the care of a household.

HYGIENE AND SAFETY.

The employer is responsible for seeing that the workrooms, motors, machines, and appliances are arranged so as not to endanger the health or life of the employees. Especially there must be good light, sufficient space, arrangements to renew the air, and to carry away the dust, lint, waste, etc., resulting from the work. All moving parts of machines must be protected from the workers by covers, and all measures of precaution must be taken to avoid dangers inherent to the work, comprising the danger from fire. The employer must have regulations and instructions assuring the conduct of the work in a manner exempt from danger. The employers must maintain these regulations and they are required to see that their operatives keep order and act with propriety and morality. It is specially recommended wherever the nature of the work permits that the sexes be separated at their work. Separate clothes rooms, toilet rooms, etc., must be provided for men and women. Such rooms must be installed in sufficient numbers for the number of workers employed and according to the laws of hygiene. Where youthful workers are employed the employer must keep a special watch over them, to see that they keep the laws of hygiene and good manners necessary for their age. In certain cases the police are directed to inspect plants and direct alterations, such as providing halls in cold weather for the workers to take their meals in, etc.

CONTRACTS BETWEEN EMPLOYER AND EMPLOYEE.

Contracts between employer and employee shall ordinarily include a provision for two weeks' notice before the contract is terminated, but by special arrangement between employee and employer this notice in regard to termination of employment may be of any duration desired, but it must be equally binding on both.

The worker may be discharged without the notice required by his contract only under the following circumstances: False representations of the worker in making the contract; theft or other criminal acts; leaving work without permission or refusing to fulfill the contract; carrying fire or lights about contrary to order; acts of violence or gross abuse directed against his employer, his family, or representative; willful damage to property of employer or fellow-workmen; inducing members of the employer's family or his representative to behave in a manner contrary to law or morality; inability to continue work or a contagious disease. In such cases there is due to the worker no indemnity, but in the first seven cases he can not be summarily dismissed without a first warning if the facts in question have been known to the employer for over a week.

The operative may quit before the completion of his contract in the following cases only: If he is incapable of continuing work; gross abuse by employer or his representative against the worker or members of his family; the inducing, by employer or his representative, of members of the worker's family to behave in a manner contrary to law or morality; nonpayment of wages in the prescribed manner; if the continuation of the work is dangerous to the health of life of the worker in a manner not included in the contract; unjustifiable prejudice; neglect to provide sufficient work for pieceworkers.

An employer who engages a workman knowing that he has not fulfilled his contract with his former employer or who entices him away from such employer is liable for damages therefor.

POSTING OF REGULATIONS—EMPLOYMENT OF CHILDREN.

There must be hung up in conspicuous places in every factory the rules under which the factory is operated, stating the hours of work, the intervals for meals, the time and manner of paying wages, the length of notice required for

terminating work, and the conditions which render notice unnecessary, and particulars of punishments, including fines and the objects to which they are to be applied. Before promulgating any rules they must be submitted to a committee of the workmen for consideration, and then with any written amendments or objections from them submitted to a factory inspector and be approved or amended by him before issuing. After promulgation the rules are binding on both employer and employee.

It is forbidden to employ children under 13 years of age. Children under this age are compelled to attend school. Between 13 and 14 years of age they may be employed if an inspector decides that they are no longer liable for school, but in this case they can not be employed over six hours a day. Youthful workers between 14 and 16 years of age can not work over ten hours a day. They must not be employed before 5.30 o'clock in the morning nor later than 8.30 o'clock at night. They must have regular periods for rest. The children who work six hours must have at least a half an hour pause. Youthful workers between 14 and 16 must have at least an hour at midday and a half hour in both forenoon and afternoon. If they do not work over eight hours a day the short rests may be omitted if there is no continuous period of work over four hours. During these rests they are forbidden to stay in the factory and should be out in the open air.

EMPLOYMENT OF WOMEN—OVERTIME WORK.

Women must not be employed in the factory at night between 8.30 and 5.30 o'clock, nor on the days before Sundays and holidays after 5.30 o'clock p. m. Women over 16 can work up to eleven hours a day, but not longer, and not over ten hours a day on Saturdays and the days before holidays. After January 1, 1910, according to the law just passed, women can not work over ten hours a day. Women who have households to manage can leave a half hour before the midday stopping time, unless the midday rest is at least an hour and a half. Women who are accouched are forbidden to work for four weeks thereafter and only within six weeks on a doctor's certificate.

When an employer engages a worker under 16 he has to hand a written notice to the police, giving the hours of work, the time at which they commence and stop, the hours for rest, and the nature of the occupation. A copy of the law as it relates to work by minors must be posted up in rooms where such minors are employed.

In case of urgent work and on demand from the employer the administration can authorize operatives over 16 to work as long as thirteen hours a day and up to 10 o'clock at night for two weeks. After January 1, 1910, the new law limits overtime to twelve in place of thirteen hours. This authorization can not include more than forty days in one year for any one factory. Authorization to work overtime more than two weeks running can only be given by the higher authorities, and more than forty days is only allowed in case the total number of hours per year, divided by the total number of days worked, does not exceed the maximum fixed by law—that is, eleven hours for adult women. The demand must be made in writing and a reply given within three days. In case of the interruption of work by flood, fire, or accident, there may be overtime worked for four weeks by permission of the higher authorities; for longer than that only by special permission of the chancellor.

GENERAL REGULATIONS.

There is no legal regulation of the hours of work for men, but for women it is eleven hours, except on Saturdays and days before holidays, when it is ten, and as there are a large number of women employed in the factories, this practically fixes the working hours of the factory. Since the first part of 1906 there have been a large number of mills running only ten hours a day instead of the legal eleven, partly because of demands made by the unions and partly from the altruistic attitude of some employers, which have forced others to follow to retain their workers. The real time is less than the nominal time by from a half to three-fourths of an hour, as women are allowed to leave a half hour before midday, and this can not be counted against them, and in some cases the afternoon rests are not deducted. Under the restrictions imposed by the new law with regard to women, etc., all German cotton mills in 1910 will be forced down to sixty hours a week as the maximum. Factory inspectors of the Imperial Government are appointed to see that the law is carried out, and factories where women or youthful workers are employed must be visited once every six months. A few of these inspectors are women.

EMPLOYEES' COMPULSORY INSURANCE.

WORKING PEOPLE PROTECTED AGAINST ILLNESS, OLD AGE, AND ACCIDENT—PROVISIONS OF THE LAW.

Paternal laws have been enacted in Germany of more far-reaching character than those enacted by any other nation, and prominent among such laws are those in regard to compulsory insurance of workmen. Compulsory insurance applies to all workers in Germany, textile or otherwise, and some understanding of its ramifications is necessary in contrasting the position of both mill owner and operative in Germany with those of other nations. Every worker, whether male or female, who receives under $476 a year, has to insure against sickness and against old age or invalidity, and has to be insured by his employer against accident.

Sick insurance provides against temporary illness during a period not to exceed twenty-six weeks. Old age and invalidity insurance provides for prolonged illness after twenty-six weeks and for permanent incapacity through chronic infirmity or old age. Accident insurance provides for relief during temporary disablement, permanent support in serious disablement, burial expenses, and assistance to widows and orphans in case of death.

Of the sick insurance two-thirds is paid by the employees and one-third by the employers; of the old-age and invalidity insurance half is paid by the employees and half by the employers, while the accident insurance is borne by the employers alone. The sick insurance premium varies between 2 and 4 per cent of the wages paid, and the old age and invalidity premium amounts to about 1 per cent of the wages paid. The portion of this burden borne by the employee is therefore not heavy, but is nevertheless felt.

The law in regard to compulsory insurance against accidents was enacted July 6, 1884, and this was followed December 1, 1884, by the law in regard to compulsory insurance against sickness. On June 23, 1889, there was passed a compulsory law in regard to old age and invalidity, and this law was amended to its present form July 13, 1899.

SICK INSURANCE.

This law has been modified three times since its inception, the last time in 1903. Every German worker, of both sexes, receiving under $476 a year must be insured against sickness, but this insurance may be either public or private. In the factories all workers are in-

scribed as members of the sick insurance fund, unless they produce testimony that they are insured in a private company that meets the requirements of the law. At every pay roll two-thirds of the premium required is retained by the company and added to the one-third paid by the company is turned over to the sick fund.

A good many factories pay two-thirds of the premium and only leave one-third to be paid by their employees, but it is illegal for the employer to pay over two-thirds. In some few factories where the sick fund has been long established there is an accumulated fund, and the interest from this fund reduces considerably the premium to be paid. In other factories where there has been more sickness it sometimes happens that the full amount allowed by law does not suffice, and in this case the factory usually makes up the deficit voluntarily.

COLLECTION AND DISTRIBUTION OF FUNDS—SPECIAL INSURANCE.

The funds of the sick insurance are collected and distributed in each district by trade associations of that district. A meeting is held by each association at least once a year and a committee appointed to control the collection and distribution of the funds. The meeting is composed of delegates elected by the workers, usually to the number of 5 or 10 per cent of the insured that they represent, and the employers are represented in both meeting and committee according to their proportionate contributions, each factory being represented. The regulations, after consultation with all interested, are laid down by the meeting and approved by the higher board of management. This institution has legal personification and considerable powers of self-government, though under the superintendence of the State. Disputes are settled by local boards of arbitration formed in each district. For the furthering of their mutual interests several sick-fund institutions can form themselves into cooperative associations.

District sick insurance is an enlarged arrangement for complying with the demands of the law regarding compulsory insurance. All those belong to the district sick insurance who are not provided for in the other admissible forms of sick insurance. The management of the district sick insurance is undertaken by the representatives of the district. Under certain conditions a mutual sick-fund association can be formed for several districts.

Membership in special sick insurance institutions, such as registered charitable funds associations, builders' sick funds, etc., which comply with the requirements of the law, release one from the ordinary sick-insurance funds.

Factories may set up a special sick fund for their own employees if the number of such employees are over 50, and this becomes obligatory on the request of the district board of management or of the sick institution to which the workmen belong. The employers can also be forced to form such a sick fund among their employees if there is good reason to fear special danger of illness in their factories.

CLASSIFICATION OF OPERATIVES—MEDICAL TREATMENT AND BENEFITS.

As every worker is enrolled on some sick insurance fund, this means that before employment in Germany every worker has to be physically examined. He is then tentatively engaged, but the en-

gagement is not considered binding until after two weeks' trial. If he is found to be incapacitated from work or suffering from any disease, then the sick fund to which he belonged at his last place of work is compelled to charge themselves with his relief or he has to be looked after by the sick fund of his community.

The operatives are divided into eight classes, according to their wages per day, the first class having an average of 1 mark (23.8 cents), the second of 1.50 marks (35.7 cents), and so on to the eighth class, which has an average of 5 marks ($1.19) a day. The sick benefit amounts to 50 per cent of the wages of the class to which he belongs, and is thus 50 to 250 pfennigs (11.9 to 59.7 cents) per day. In special cases this indemnity is allowed to be raised to three-fourths of the average wages of his class.

In case of sickness there is furnished gratuitously on the first day free medical treatment, with medicines, medicaments, bandages, spectacles, trusses, or other appliances that will enable the patient to continue at work or to hasten his cure. After three days there is rendered sick-benefit wages. This indemnity is payable every Saturday, and continues as long as the illness lasts, if not over twenty-six weeks. The sick-fund assistance ceases at the latest at the expiration of the twenty-sixth week after the commencement of the sick payment. For continued illness after twenty-six weeks, whether temporary or permanent, the burden rests on the old-age and disability fund.

TREATMENT OF SPECIAL CASES.

In case of illness for which the patient himself is to blame, as, for instance, through fights, blows, drunkenness, etc., the associations or communities are to decide for themselves whether sick payment shall be rendered at all or partly.

In case of maladies that it is impossible to treat advantageously at home, especially in the case of contagious diseases, the committee of the sick fund may have the patient treated at a hospital. In this case, if the patient is a single person, he only receives one-fourth of the sick benefit he would otherwise be entitled to, but is under no expense at the hospital. In the case of a married man, having a wife or family dependent on him, he may receive the full benefit as if treated at home, if circumstances justify it. In the Rhine province and some other sections the patient has the right to choose his own doctor.

Women accouched receive sick benefit for six weeks. They are not allowed to work for four weeks and not until the full six weeks, unless on a doctor's certificate.

DEATH BENEFITS—PREMIUMS AND TOTAL RECEIPTS.

In case of the decease of a member of the sick benefit fund his family receives an indemnity equal to twenty times the average daily wages of the class to which he belonged, this indemnity therefore ranging between 20 and 100 marks ($4.76 and $23.80). Some sick funds give also in case of the decease of members of the family of one of their contributors.

The maximum sick fund premium is fixed by law at 4 per cent of the wages, of which the employee is to pay two-thirds and the employer one-third, but the premium is usually 2 or 3 per cent.

The total receipts yearly by the sick funds amount to some 250,000,000 marks ($59,500,000) and the expenditures to nearly as much. The largest expenditure is for sick indemnities to workmen, amounting to nearly one-half of the total, then for doctors, then, in their order, for medicines and appliances, hospitals and clinics, payments to widows and orphans, etc.

INVALIDITY AND OLD-AGE INSURANCE.

Persons compelled to take this insurance are all workers of 16 years of age and upward, such as workmen in factories, laborers, daily paid workmen of all kinds, servants, journeymen, clerks, overseers, foremen, private teachers (with salaries under 2,000 marks, or $476), technical experts, etc. The exemptions are invalids, persons entitled to pensions, as, for instance, teachers employed by the State, etc., persons who do not work for regular wages but temporarily tender services from time to time, and those who obtain their board and lodging as payment for their work. On request the following persons can be exempted from this insurance: Those who already draw pensions or accident premiums, those over 70 years of age, those who are not employed more than twelve weeks a year for wages; the latter, however, must have been already insured for at least one hundred weeks. The applications for release must be presented to the authorities in writing, and such persons receive a green card signifying their release from compulsory insurance. Compulsory insurance extends to those following a household occupation in the tobacco and textile industries.

PREMIUMS AND METHODS OF PAYMENT—CLASSIFICATIONS OF INSURED.

The payments of invalidity and old-age insurance premiums is divided equally between employer and employee, and it is a misdemeanor for the employer to pay more or less than one-half. Every insurer is supplied with a pocketbook containing a card available for one year. The card and the book give the name and the occupation of the insured. The card has lines for the inscription of the days of sickness and of military service. It is divided into 52 squares, destined to receive 52 stamps each of the value of the weekly contribution. Each week a stamp must be bought and pasted in, and this must be defaced by writing thereon the date. These stamps can be bought at the post-office or at certain special bureaus.

Usually the employer deducts half the premium, pastes in the stamp for the full amount, and then returns the book to the employee. The employer is forbidden to retain the book after pasting in and defacing the stamp. When there have been 52 stamps put in, filling all the squares, the book is turned in and another one furnished. There is allowed a maximum delay of two years in the filling in and delivery of the card before the workman loses his insurance rights. Weeks during which the employee was sick or in military service count as weeks of payment without pasting in any stamps, but a certificate must be furnished to prove sickness. Also women accouched are allowed to count six weeks without stamps as payment weeks.

The insured are divided into five classes according to wages received, as follows:

[100 pfennigs=1 mark; 1 mark=23.8 cents.]

Class.	Annual wages.	Weekly payments.	Class.	Annual wages.	Weekly payments.
	Marks.	*Pfennigs.*		*Marks.*	*Pfennigs.*
First	Under 350	14	Fourth	850 to 1,150	30
Second	350 to 550	20	Fifth	Above 1,150	36
Third	550 to 850	24			

RETURN PREMIUMS—TREATMENT ACCORDED THE INSURED.

Half of the premiums paid are returned under the following conditions: In case of the death of the insured after he has paid at least two hundred weekly premiums; in case of invalidity due to accident, if the contributions paid for insurance against accident are more than those to which the insurance against invalidity have given the right, and the assured has paid at least 200 premiums; in case of the marriage of a woman who has paid at least 200 weekly premiums.

Temporary illness up to twenty-six weeks is a charge on the sick insurance fund. After twenty-six weeks it becomes a charge on the old-age and invalidity insurance fund, and the patient has the right to all attendance, medicine, and appliances that may tend to effect a cure, such as massage treatment, treatment with special baths, operations from time to time by specialists, treatment in hospitals, sanitariums, houses of convalescence, etc. In cases of tuberculosis they are transferred to special tuberculosis sanitariums and given open-air treatment, etc. Convalescents are given food suitable to their case, even at their homes. If their illness incapacitates them for their former occupation they are maintained during their apprenticeship at another trade to which they may be suited. In this way many workers are prevented from becoming a permanent charge on their relatives or the State, and enabled to become able to again sustain themselves either wholly or in part.

YEARLY REMUNERATION OF THE INVALID AND AGED.

The yearly remuneration received by an invalid is divided into three parts: A fundamental sum corresponding to the class in which he was insured based on his regular wages; a sum that is obtained by multiplying the number of weekly payments made by a weekly coefficient fixed by law; a fixed indemnity, furnished by the Government, which runs from 50 to 62 marks ($11.90 to $14.76). The fundamental sums and the weekly coefficients for the five classes previously noted are as follows:

Class.	Fundamental sum.	Weekly coefficient.	Class.	Fundamental sum.	Weekly coefficient.
	Marks.	*Pfennigs.*		*Marks.*	*Pfennigs.*
First	60	3	Fourth	90	10
Second	70	6	Fifth	100	12
Third	80	8			

For example, suppose one has paid 800 weekly premiums of class 4 and then becomes incapacitated for work he will receive the following: The fundamental sum of class 4, 90 marks ($21.42); 800 payments of class 4, 10 pfennigs per payment, 80 marks ($19.04);

indemnity from the Government, 50 marks ($11.90); total yearly return, 220 marks ($52.36). In this case the insured after working sixteen years had paid 120 marks ($28.56) (the other half having been paid by his employer) and on becoming incapacitated for work, which might be at the age of 33, if he started work at 16, he receives for the balance of his life 220 marks ($52.36) a year.

In regard to old age the conditions are: (1) Having attained an age of 70 years; (2) having paid at least 1,200 weekly premiums, which would take twenty-four years. As the law was only promulgated in 1889, to take effect January 1, 1891, there has not yet been any entitled to the old-age pension under the second condition. For all persons who were over 40 years of age when the new insurance came into effect at the end of 1890, the waiting time of 1,200 payments is shortened by as many years over forty as they were at that time, and in this case the year is considered to be of forty payment weeks. For example: A worker born in 1830 attained his seventieth year in 1900. He was 60 years old in 1890, or twenty years over the forty noted as the minimum. His waiting time was reduced from 1,200 by 800 weeks, leaving him only 400 weeks to pay.

The yearly sum paid as old-age pension is calculated on the basis of the number of weekly premiums paid times a coefficient fixed by the national administration for each class. The following are these coefficients: Class 1, 60 marks; class 2, 90 marks; class 3, 120 marks; class 4, 150 marks; class 5, 180 marks.

GOVERNMENT INDEMNITY PAYMENTS AND RECEIPTS.

In addition the Government adds a fixed indemnity of 50 marks ($11.90). For example, suppose a worker born in 1835: He was 55 years old in 1890, and in 1905, when he became 70 years old, he demands an old-age pension. He has made 700 weekly payments, of which 100 were in class 3, 200 in class 4, and 400 in class 5. The payments in the lowest class are disregarded by the law, so his total payments under classes 4 and 5 amount to 1,020 marks ($242.76), and this divided by 600 to obtain the average, which is found to be 170 marks ($40.76). Add to this the 50 marks ($11.90) of the Government and we obtain 220 marks ($52.36) as the yearly old-age pension to be paid in this case. To obtain this yearly pension the worker has paid 100 premiums of 12 pfennigs each, 200 premiums of 15 pfennigs each, and 400 premiums of 18 pfennigs each, or a total of 114 marks ($27.13) only. This is only half the sum that has been received as premiums by the Government, as it will be remembered that the employer pays the other half.

The sum received by the Government yearly for the old-age and invalidity insurance amounts to some 200,000,000 marks ($47,600,000), of which part is premiums and part interest on funds on hand and investments. The yearly distribution amounts to only about 150,000,000 marks ($35,700,000) a year, so that there is a yearly increasing surplus, which at present amounts to over 1,000,000,000 marks ($238,000,000), and this is exempted by law from being drawn on for any other purpose than that for which it was paid in. In 1914, when the second clause of the old-age pension comes into effect—that is, of men being entitled to a pension who have paid in premiums regularly for twenty-four years—there will undoubtedly be a large draft made on this surplus.

POPULARITY AND GOOD EFFECTS OF THE LAW.

The old-age and invalidity insurance is very popular in Germany, and when the law was modified and extended in 1899 all classes voted in its favor, so that it was almost unanimously adopted. One effect it has had that is very noticeable from the statistics, viz, the decrease in the death rate. There is hardly any doubt but that this decrease is due to this law, especially the decrease in deaths from tuberculosis. The ordinary workman, relying on his own savings, is not able to secure treatment necessary to effect a cure, but under this law he obtains this free, and the large number of special sanitariums and hospitals erected by the Government for the treatment of special diseases have saved many lives, while the oversight exercised by the insurance funds over the worker, by checking illnesses at the start, have saved many more. The associations, in furtherance of the health of the operatives, have invested large amounts from their surplus funds in erecting sanitary homes for the workers, and this also has been of great benefit.

The old-age and invalidity insurance funds are administered by special associations and institutes which are established for large districts or for whole States. Each has a president, who has the standing of a Government official, and an executive committee composed of an equal number of employers and employees, not less than five of each. The employees are not only represented on the district committee, but on the central board and in the tribunals of experts. Each district has at least one arbitration board, with an independent chairman, nominated by the Government, and assessors representing equally employers and employees. General supervision is exercised by the imperial insurance office.

Persons insured can choose a higher class than that to which they belong should they undertake to pay the extra cost. Optional insurance is possible in all grades of wages.

ACCIDENT INSURANCE.

Insurance against accidents in Germany is a special organization and is a mutual insurance among employers. Groups are formed of the employers in certain industries in specific localities. Thus cotton and woolen manufacturers are placed together and are divided into five groups: South Germany, north Germany, Saxony, Silesia, and Prussian Rhine and Westphalia. All workers must be insured by their employers if such workers make under 3,000 marks ($714) a year, the annual wages being calculated as 300 times the daily wages.

The five textile associations, composed of all the cotton and woolen manufacturers in their respective districts, are legally incorporated bodies and have considerable powers of self-government. They fix their own regulations, and these are carried out by a duly appointed committee, but they are under the supervision of the imperial authorities. The committee is usually appointed for six years, and one-third of the members are renewed every two years. They fix the amount of indemnity in case of accidents, give orders to factories to install safety appliances, such as coverings for machines, etc., and can levy fines on factories which do not obey such orders. They decide on what measures are to be taken to fix the blame for an accident, direct what treatment is to be received by the injured, etc., and have the entire control of the receipts and disbursements of funds.

PROVISIONS, OPERATIONS, AND BENEFITS.

The workers are not members of this association as they pay nothing toward it, it being entirely supported by the employers. The injured man, however, is supported for the first thirteen weeks at the cost of the sick-insurance fund to which the workers belong, and from which he receives a fixed daily indemnity. After the thirteenth week the Employers' Accident Association takes charge of the case.

In case of an accident the employer has immediately to notify the police and the accident association in writing. He has three days in which to make this declaration. The injured man is taken in charge by the sick fund and for the first four weeks receives one-half of his regular wages and from then up to the end of the thirteenth week two-thirds of his regular wages, the sick fund paying one-half and the employer one-sixth.

If the injured man is treated at a hospital and is married, he receives one-fourth of his regular wages up to the end of the fourth week, and then one-third up to the end of the thirteenth week. He is then under the care of the Employers' Accident Association, and this association may request the sick fund to continue the treatment at its charge or it may take charge of the case itself. In this latter event the patient is specially examined by doctors. If judged necessary for his cure, he is sent to special baths, to mechanical-therapeutical establishments, to convalescent houses, etc. He is then examined anew and the degree of his incapacity is stated in percentage of total incapacity for work. If totally incapacitated for work he receives two-third of his regular wages, and if partially incapacitated, from 15 per cent up, according to the degree of incapacity stated by the doctors in percentage. When not only incapacitated from following his trade, but totally helpless, he may receive the full amount of his regular wages. When out of work, in consequence of the accident, either part or full wages are paid, according to circumstances.

RIGHT OF APPEAL FROM INDEMNITY ALLOTMENT.

The injured man has a right to appeal if he thinks the percentage stated by the doctors, and hence his consequent indemnity, too small. Also at any time for five years after the accident he has a right to demand increased indemnity if his incapacity increases, and, vice versa, the association has a right to cut down his indemnity if there is noted an improvement in his condition, such questions to be legally decided by boards of experts. After five years there can be no change without special authority from those higher up.

The indemnities are payable by post monthly in advance. The funds necessary are supplied by assessments levied on the members of the association based on the expenses of the preceding year. If all the employers are in industries with equal risks the assessment is the same for each, proportionate to his total wages paid. This is never the case, however, and each association fixes the percentage to be paid by each branch of the industry according to the percentage of accidents that their records show to come from this branch. Thus in cotton manufacturing most factories show the largest percentage of accidents to be from the electrical installations, then spinning plants, then bleaching, dyeing and finishing, then twisting plants, then weaving, then knitting, etc. The percentage to be paid by each

manufacturer on his total wages is thus fixed according to whether he has spinning only or spinning and twisting, etc., being mathematically computed according to the ascertained coefficients, and these coefficients being changed each year according to the proportion shown by the preceding year.

APPORTIONMENT OF ASSESSMENTS—PAYMENTS TO FAMILY OF ASSURED.

It has been found in practice that there is rarely any great variation in these coefficients—that is, in a certain district the proportion of accidents from spinning mills, from weaving mills, from dye works, from knitting mills, etc., will be found to show a remarkable conformity year after year, unless there is some important change made in the methods of work. Where one mill shows a much higher proportion of accidents than the average, this mill has its danger coefficient increased correspondingly, and the committee examines the mill to ascertain the causes of such accidents and may order special safeguards provided where found necessary. For spinning mills the ordinary assessment will be about 1 per cent of the total wages, whereas for weaving mills it is usually not much over one-half of 1 per cent.

In case of death from accident the family of the assured receives: Burial money equal to one-fifth of the average annual wages, and this sum must not be under 50 marks ($11.90); the widow is paid a yearly allowance of 20 per cent of the annual wages of the deceased until her death or remarriage, and two children under 15 years of age may receive 20 per cent each until they reach the age of 16; if there are other dependent relatives they may also get 20 per cent if in want, but the total allowance must not exceed 60 per cent. A widow who remarries receives one payment of 60 per cent in full of all claims on the fund.

If it is proved that the accident was voluntary on the part of the worker he gets nothing, and there are severe penalties if a patient is found to be exaggerating his injuries to obtain a larger pension. Also, if an accident is due to the culpable carelessness of the employer in neglecting proper precautions then he is liable for all damages and the association is not held responsible.

TRADE ORGANIZATIONS.

ESTABLISHMENT AND OBJECTS OF WORKMEN'S UNIONS—ORGANIZATIONS AMONG THE EMPLOYERS.

In 1731 organizations of workmen in Prussia were absolutely forbidden by law. This law was partially repealed in 1848, but soon put in force again, and was not finally abolished until 1868. They then increased rapidly, and as many were socialistic, and even revolutionary, in their scope the Government deemed them a menace and in 1878 once more passed laws against such unions, which had the effect of suppressing large numbers of bodies of workmen. In 1890 these restrictions were finally removed and nearly one-tenth of the German workers are now estimated to belong to some union. Some unions were started from economic, intellectual, or religious motives, but practically all have become socialistic.

There are now a great number of unions and subunions, but the great bulk of these are embraced in the following five groups: (1) The "Free" or Social Democratic Gewerkschaften; (2) the "Christian" Gewerkschaften; (3) the "German" or Hirsch-Duncker Gewerkvereine; (4) the Evangelical Workers' Unions; (5) the Catholic Workers' Unions.

THE FREE TRADES' UNION.

The Social Democratic Gewerkschaften, or, as it is usually known, the Free Trades' Union, is by far the most important and embraces some 1,100,000 of the total 1,500,000 union operatives in Germany. Of the 60,000 women in German unions some 48,000 belong to this organization. It is also the union that appeals most strongly to the textile workers, and of some 45,000 men and 20,000 women of the textile industry in unions, 41,000 men and 13,000 women are "Free" unionists. The largest group of workers belonging to the Free Union are the metal workers, then the masons, the wood workers, and the miners, the textile group ranking fifth.

This union was founded in 1867 and is the oldest of modern German trades unions, with the exception of the smaller unions of the tobacco workers, founded in 1865, and that of the typographers, founded in 1866. All three of these were started before the old law forbidding such organizations was abrogated. The headquarters of the Free Union is at Berlin. It is a very powerful body of workers and is carefully organized. Each class of workers is grouped by themselves, according to sections, and these again subdivided. For instance, all textile workers around Augsburg are entitled to join the textile branch of this union, but are subdivided into the carders' union,

the spinners' union, the weavers' union, the hosiery workers' union, etc., and the head of the general union at each center reports to headquarters at Berlin.

The objects of this union are educational, economic, and socialistic. The educational part is devoted to the education of the worker along technical lines, supplementing the primary school education by lectures, conferences, etc., and arranging apprenticeships. The economic part looks toward the raising of wages and the fixing of uniform wage schedules among all workers on the same line of work; giving relief in case of strikes and lockouts, sickness, etc.; placing workers; organization of cooperative societies; construction of good dwellings for workers, etc. The socialistic part deals with the general amelioration of the condition of the workers, and is largely political. The annual assessment is from 8 to 16 marks, or say 3½ to 7 cents a week, and these assessments, with other sources of income, such as investments, interest, etc., bring in over $5,000,000 a year. The greater part of this sum is expended in sustaining strikes, agitating their propaganda by trade papers and other means. assisting the sick and invalid, relief to operatives out of work, funeral expenses, etc. The reserve fund is now about $4,000,000. The Social Democratic Gewerkschaften is supposed to be nonpolitical, but they usually work with the Social Democratic party, though they are not necessarily supporters of any one party, but are free to work with any party from which they can gain anything in furtherance of their aims. The Social Democrats are avowedly atheistic, and the Social Democratic Gewerkschaften is largely so.

THE CHRISTIAN AND GERMAN UNIONS.

This atheistic tendency of the Social Democratic Gewerkschaften is one of the main causes that led to the formation of the Christian Gewerkschaften. The center of this union is at Cologne, and they number some 225,000 members, of whom about 32,000 are textile workers. Their objects are not materially different from those of the Social Democratic Union, except that they emphasize their belief in religion, and their main objects are the amelioration of the condition of the working classes by cooperation among themselves, securing an impartial administration of the laws, and improving and extending them.

The entrance fee of the Christian Union is 50 pfennigs (11.9 cents), but their yearly dues are higher than those of any other German union. These dues are varied according to the average wages received in the various trades, but run from about 15 to 30 marks ($3.57 to $7.14) a year. Their yearly receipts are about $600,000, and they have a reserve fund of about $300,000. Most of the railroad and post-office employees belong to this union. In spite of their religious prejudices against the Free Union they work with it for the attainment of political ends.

Another union that exercises a strong influence is that called the German or Hirsch-Duncker Gewerksvereine, the latter name coming from its founder, Doctor Hirsch. Their objects are especially the securing of higher remuneration for work performed. They also agitate for the modification of labor laws in favor of the working classes, the betterment of conditions of work; they give aid in case

of sickness or of stoppage of work, form cooperative societies, instruct workers and give them free counsel, and interfere in cases of difficulties between workers and employers to settle the disputes and arrange wage schedules, etc. They are organized into different trades and these subdivided. Their total membership is about 115,000; only some 6,000 textile workers belong to this union. The object of this union was at first purely economic, but it is now more socialistic. The yearly dues are 10 marks ($2.38). Their reserve fund is about $800,000.

EVANGELICAL AND CATHOLIC WORKERS' UNIONS.

The Evangelical Workers' Unions, formed about 1880, are divided into five main branches, which lie in Westphalia, Rhine, Saxony, Silesia, and Baden. Their object is to elevate the worker morally and intellectually, but their lines of work are not materially different from the three socialistic unions noted. They started as anti-socialistic, but most of their 150,000 members lean strongly toward socialism and are active politically. Their main strength lies among those engaged in commerce, such as clerks, bookkeepers, agents, employees in hotels and restaurants, etc., and very little among factory workers. They run a paper to exploit their views, possess libraries, savings funds, relief funds, bureaus for consultation and for placing workers, etc.

The Catholic Workers' Unions were started about 1885, and there are three main unions, those of the south, the east, and the west. Their objects are similar to that of the preceding unions, and they strive to raise the moral and intellectual level of their members within Catholic lines by means of religious and economic conferences. They issue a weekly paper, distribute tracts, and are active politically in furtherance of their aims. They work usually in conjunction with the Christian Workers' Union.

ORGANIZATIONS OF EMPLOYERS.

The rapid increase of workers' unions and their increasing insistence on shorter hours and higher wages has within the last few years led to similar organizations being formed among the employers for mutual protection.

There have been organizations among German manufacturers and employers in general for a long time, but such organizations were mainly local or for commercial purposes, for fixing or changing tariffs, etc. In 1876 there was formed in Berlin a central union of the German industries, the object of which was to develop and extend German trade. In 1904 the strike that broke out among the vigogne spinning mills at Crimmitzschau, in Saxony, fixed the attention of manufacturers on the necessity of having a stronger organization to combat unjust demands of workers, and, at the suggestion of the Saxon manufacturers, the committee of the central union of German industries called a meeting of German employers, which decided to create a central association of the united employers of Germany. Eleven members were appointed to draw up plans and act as an executive committee in establishing the new association. They immediately wired to all manufacturers and in forty-eight hours had collected some $75,000, and this was later added to largely.

This Central Association of the United Employers of Germany is now strongly organized and in its scheme of defense it embraces all the industrial unions of Germany. It was comparatively easy to organize the German manufacturers for the reason that the insurance laws of the Government had already forced all those in a certain trade in a certain section to work together on boards to administer insurance funds, examine injured and sick operatives, and to see that each factory had proper safety appliances, etc. They were, therefore, accustomed to working together and when menaced by this new danger they organized quickly on the new lines suggested.

This central union is composed of representatives from all the various German employers' unions, and they have subcommittees in each large industrial center representing all the employers' unions in that section. It is a principle among all these associations to try to avoid strikes and lockouts by all means possible, and to this purpose to have conferences with their workers, but to refuse absolutely to listen to representatives of outside organizations of workers.

OBJECTS AND RESTRICTIONS.

The special object of this central union of the employers' associations is announced to be as follows: To protect employers against unjustifiable demands of workers' unions; to protect those who desire work; to extend and develop the bureau for supplying employers with operatives; to execute decisions relative to strikes; to take charge of the legal protection of its members in all cases in which fundamental principles are at stake.

The central union endeavors to gain the adhesion of all manufacturers. It has a bureau for supplying information to members concerning movements of workers and their qualifications, and in regard to the causes and progress of strikes and the means to combat them, etc. Manufacturers may be refused the right of joining this union if their factories are isolated and at a distance from industrial centers, or for other reasons considered just by the majority of the executive committee, and members may be dropped who refuse to conform to the rules or the decisions of the executive committee or who by their acts endanger the interests of the association.

There is a general meeting once a year and funds are supplied according to a fixed assessment. Every member is supposed to work in the common interest by refusing to pay excessive wages, refusing demands for a reduction of the hours of work at his factory alone, refusing to employ workers who have quitted another employer in a manner unjustifiable or illegal, refusing systematically all interference by workers in the management of the factory and especially in regard to the employment and discharge of workers, and to conform fully to lockout decisions of the committee.

One of the most recent conflicts between the employees and the employers' associations resulted in the victory of the former. This was in regard to the amendments to the working law which were passed in December, 1907, and where the workers' unions, against the strong protest of the manufacturers, had the law modified so that after January 1, 1910, women can not work over ten hours a day, instead of eleven, thus reducing the maximum weekly factory hours to sixty, the substituting of twelve for thirteen as the legal hours per day in cases of temporary overtime permitted in certain cases, and other provisions along the same line.

TEXTILES FROM COTTON WASTE.

SKILLFUL METHODS OF UTILIZATION BY MANUFACTURERS—IMPROVED MACHINERY REQUIRED BY THE MILLS.

In Germany the manufacture of cotton waste into a great variety of finished products is quite an industry. Not only do the mills manufacture the waste from German cotton mills, but they also import cotton waste from all sections of the globe and, in many cases, ship the manufactured article back to the country from which the waste was bought. The cotton waste imported is listed as cotton linters, or as waste from cotton mills. The following table shows the import of cotton linters into Germany for the year 1907:

Country.	Pounds.	Country.	Pounds.
United States	38,069,912	Great Britain	1,128,228
British India	14,450,306	All other countries	2,249,402
China	2,680,284		
Dutch India	888,653	Total	60,381,225
Egypt	914,440		

Of the linters reexported, 6,158,417 pounds, the bulk goes to waste mills in northern Austria and the remainder to other neighboring countries.

The waste from cotton mills—sweeps, flyings, strips, etc.—imported into Germany for 1907, and the cotton-mill waste exported to other countries during the same period, is shown by the following table:

Country.	Imported.	Exported.	Country.	Imported.	Exported.
	Pounds.	*Pounds.*		*Pounds.*	*Pounds.*
United States	3,409,373	6,083,701	Japan	721,590	
Austria	16,179,564	14,540,449	Netherlands	10,946,607	15,718,928
Belgium	4,063,294	4,843,510	Switzerland	4,547,513	1,494,092
British India	1,025,742		All other countries	2,497,347	3,980,922
France	13,530,136	5,132,014			
Great Britain	13,906,358	912,456	Total	72,379,360	52,994,098
Italy	1,551,836	279,026			

It will be noticed that several countries both ship waste to and import waste from Germany. France and Austria, for instance, ship waste to Germany from various places, while Bohemian waste mills import waste from the German mills near at hand, and Alsace-Lorraine ships some waste over the French border. Germany buys all kinds of cotton waste from the United States, but especially soft waste, such as sweepings, flyings, and strips. Some of this goes into the manufacture of coarse towels, scrubbing cloths, dish rags, blankets, etc., which is then exported back to the United States or to the Philippines.

COTTON-WASTE CLOTH—VIGOGNE YARN.

Ten samples of this class of goods, which are made from American waste manufactured in Germany and then sold in the United States, are transmitted with this report. In some of these articles both warp and filling are made from cotton waste, while in others the warp will be jute, coarse linen, or other strong material and the filling cotton waste. The yarns employed are usually between number .75 and number 6, while in some of the finer grades the waste yarns used run up to 8s or 10s or even higher where mixed with cotton. The cotton waste shipped by Germany to the United States is mainly hard waste for use in machine wiping, etc.

"Vigogne" yarn might also be considered in connection with cotton-waste spinning. This also is an important industry, and there are over 600,000 spindles making vigogne yarn in Saxony. The real vigogne yarn consists of wool mixed with cotton and the proportion varies from 20 per cent wool and 80 per cent cotton to 2 per cent wool and 98 per cent cotton, and is used in cheap hosiery, in imitation wool cloths, etc. In place of the wool, very often wool waste is used either in whole or in part. The less wool used the greater the profit, where it resembles wool when finished. A large portion of this so-called vigogne yarn now made in Saxony is not really vigogne, but is imitation yarn and in this case cotton waste is substituted for the wool and this is manufactured on wool cards and worked so as to look like the genuine material, unless inspected at short range. The proportion of cotton, of cotton waste, and of wool (where this is used) varies according to the grade of material desired and is kept a close secret by the respective manufacturers. It is, however, simply a question of using the cheapest mixing that will obtain the particular result desired.

In the ordinary waste spinning where not over No. 6s is spun there is ordinarily used the two-card system, while for higher numbers, and always for vigogne, the three-card system has to be employed. With this exception the manufacture of vigogne or imitation yarn does not materially differ from the ordinary waste processes.

METHODS OF MANUFACTURE.

In the following notes a few brief details in regard to the manufacture of waste as carried on in German waste mills, cost and production of the machines ordinarily used, and the wages paid operatives are given.

There are two main kinds of cotton waste: (1) Hard waste, or waste in which there is some twist, is made on the spinning and subsequent machines, and consists of cop bottoms, reel waste, twister waste, etc.; hard waste has to be run through some machine to tear it up and take out the twist in this way before it can be reworked; it is graded according to cleanness, whether white or colored, and according to the machine on which it is made; (2) soft waste, which includes all waste of the machines up to the spinning frame, such as motes, card fly, flat and cylinder strips, clearer waste, clean sweepings, oily waste, etc.

There are two main systems of machinery generally used in the manufacture of cotton waste—the condenser and the coiler. The first

resembles the wool system and the latter is more similar to the cotton system of manufacture. The condenser is best for soft yarn and gives a soft and full yarn that can be used for warp and filling for blankets, flannelettes, cleaning cloths, quilts, etc. The coiler is best for waste yarns that are intended to be harder twisted and to be used for filling for towels, cloth to be printed or dyed, for twine, rope, etc. The condenser system is the one used in the majority of the German waste mills. Here, as elsewhere, some regular cotton mills manufacture their waste into coarse yarns, but, except in the case of very large mills, this is not usually to be advised, for waste manufacturing is a separate branch of the industry and to get the best results it should be in a mill by itself.

PURCHASE OF COTTON WASTE—MACHINERY EMPLOYED.

The German waste working mills buy cotton waste by sample from German waste dealers, who in turn buy from the German cotton mills or from waste dealers in other countries. The terms of commission and discount seem to vary according to the country from which brought, and also according to the individual dealer, there being no uniformly observed rules. Dealers in French waste usually give 2 per cent discount, thirty days. From England the terms are the same for cotton waste as for cotton yarn and are according to the Manchester terms of sale. Dealers in American waste stated that their usual commission was three-fourths to 1 per cent, sometimes up to 1½ per cent, and that drafts are made, with bill of lading attached, for three months, nineteen days' sight.

In Germany the waste from the mills does not usually have to be transported far and is shipped in sacks weighing some 25 kilos (1 kilo=2.2 pounds). From other countries the waste comes in pressed bales weighing 200 to 300 kilos. From the United States the waste bales are of the same size as cotton bales, about 500 pounds. Usually 6 or 7 per cent is deducted for covering.

In the usual cotton-waste mill in Germany using the condenser system the following machines are employed: (1) Opener (Baumwollöffner); (2) picker (Baumwoll-Schlagmaschine); (3) double automatic waste cards (Automatischer Zweipeigneur-Krempelsatz); (4) waste mules (Streichgarn-Selfactor).

In addition some have reels or other machines for putting the yarn up in special shapes. Instead of the mule some use a tubular cop machine, and others use a waste ring spinning frame for making yarn for specific purposes.

OPENER AND PICKER MACHINES.

In the type of opener ordinarily used, a drawing of which has been sent, the waste is first mixed by hand, very often white waste from a wadding mill being mixed with dirty sweepings to lighten up the color, or other mixing made as desired, according to the grade of yarn to be produced. This is then fed into the spout, and after being partially cleaned falls off the moving lattice at the other end, the cleaning being done by horizontal revolving blades, made very similar to the ordinary Crighton opener for cotton. One size of this opener is about 55 by 105 inches, weighs about 4,850 pounds, and sells for about $400; the other size is about 70 by 150 inches, weigh-

8,800 pounds, and sells for about $500. There is a double opener, which is about 70 by 315 inches, weighs some 17,000 pounds, and costs about $1,050, but is similar in its action to the others. In some of the openers the waste is pushed in through the spout by hand and in others it is spread by hand onto a movable lattice, which feeds it into the machine. The driving pulley is usually run at 1,000 revolutions per minute.

In a combined opener and picker, illustration of which is forwarded, the cotton as it comes from the opener is laid on a lattice, which feeds it into the picker, where it is fanned and beaten. The machine is similar in its general action to the regular cotton-mill picker, but instead of a beater with blades a cylinder is here used, covered with short projecting spikes. The cotton is not rolled into a lap, but is run up a moving lattice and allowed to fall to the floor, whence it is then carried to the hopper of the automatic double card, as described later. The picker is about 68 inches wide (for a working width of 40 inches) and 160 inches long, weighs about 6,800 pounds, and costs $650. The driving pulley is usually run at about 1,000 revolutions per minute. It takes about 3 horsepower to operate, and has a production of 3,300 pounds per day of ten hours. The combined opener and picker in question has the same width as the single opener, is about 19 feet long, weighs about 14,500 pounds, and costs $1,125 at Chemnitz. One workman is required per machine, and gets 36 to 48 cents a day.

WASTE CARDS.

One of the largest Saxon machine firms and one that ships a good deal of machinery to the United States is at Chemnitz. One of its specialties is waste cards. These, as shown in illustrations forwarded, are simply modifications of the woolen-card system. For making cotton-waste yarns up to No. 4s this firm recommends the double card. The action of the cards is clearly shown in the catalogue illustration and requires little explanation. The cotton from the breaker card is conveyed in an open lap to the roving card, where it is separated into slivers and wound up into numerous adjacent sections or cheeses on four lap sticks. The two cards work together, and one girl (usually at 48 cents a day) is the only help employed. The width is usually 65 inches, and the total weight of the two cards is 42,000 pounds. This machine makes 40 slivers on each lap, or 160 slivers total, and the production per ten hours is 550 to 660 pounds, or enough to supply some 600 mule spindles. The cost is $3,350 at Chemnitz; seapacking 7 per cent extra. The freight on machinery from Chemnitz to Hamburg is 2.5 marks per 100 kilos (59½ cents per 220 pounds), and from Hamburg to New York is $5 per metric ton. Insurance is 50 pfennigs per 100 marks (12 cents per $23.80 hundredweight).

For making cotton-waste yarns between No. 4s and 8s the firm recommends a one-comber system. This set of cards is also 65 inches width, it weighs complete 36,000 pounds, and costs at Chemnitz $2,856. It makes 140 slivers total on the four laps and produces 350 to 400 pounds of Nos. 4s to 8s yarn in ten hours, or enough to supply 600 to 650 mule spindles.

For yarns Nos. 6s to 12s the three-card system becomes necessary, and especially for vigogne yarn, which is very often made without wool, using only cotton and cotton waste. The three-card system

weighs complete 45,000 pounds and costs $3,570 at Chemnitz. The production on Nos. 6s to 12s is 275 to 330 pounds in ten hours, or enough to supply 700 mule spindles. There are 140 slivers to the four laps and the width is usually 65 inches, though any width, number of laps up to 6, or any number of slivers to the lap, can be made as desired.

TANDEM THREE-CARD PROCESS—HOPPER FEEDER.

A tandem arrangement of a three-card set is made by a manufacturer at Verdau. These cards are 65 inches wide and make 120 slivers at a time. The cost at Verdau, packing not included, is $2,737. Running on No. 6s the production per day of ten hours is given as 496 pounds. Waste mills using this system at Verdau employ one girl at 48 cents a day to run the set.

To consume the production of such a card set there are necessary two self-actors of 300 spindles, each with gage of 1.9 inches. The price of such a self-actor as made at Verdau is $857 at that place, and to attend such a self-actor two girls are employed at 48 cents each. For every 1,000 to 1,500 mule spindles a spinner is necessary at $1.19 a day.

The waste cards are not supplied with laps, but are connected direct to a hopper feeder. The ordinary hopper feeder does not feed evenly, being affected by the weight of material in the hopper and other causes, and to obtain an even yarn from the card it is necessary to have uniform feeding, so some intermediate weight-regulating apparatus must be used. This is especially necessary for the so-called automatic card sets; for the automatic supply of material from one card to another it is essential to have an exactly regular feeding of the first card. Formerly the card was fed by hand, and this method is still used in a good many mills with old machinery. The operative weighs a certain amount and spreads it by hand over a certain space on the feed apron. The weight-regulating device now used carries out just the handwork described. Formerly the evenness of the yarn varied according to the conscientiousness and ability of the operative, while the mechanical device works automatically and does the work more exactly and at less cost. This weighing device is made in different shapes and styles by different firms, but the method of all is similar.

In using weighing devices on this machine made at Chemnitz the raw material is drawn out of a hopper by the usual spiked lattice, but instead of falling onto the feed apron it drops into a weighing trough. The two bottom plates of this trough are hinged and are balanced so that they only open when a certain fixed weight has been supplied. As soon as the correct amount has been dropped into the weighing trough the spiked lattice is automatically stopped, the two bottom plates drop down, and the waste is shed out on the feed apron, where it is immediately spread out evenly by a swinging presser arrangement and feeds on into the card. As this moves forward the bottoms of the weighing trough close up, the spiked lattice starts delivery again, and the process is repeated as before. This apparatus can be adjusted so that the speed of the feed apron, the weight of the material to be put in the weighing trough, and the frequency of its

emptying, can be arranged according to the different materials to be worked. The attendant has only to keep the hopper supplied.

WASTE SPINNING ON MULES.

The waste mule differs from the regular mule used in cotton mills in that there are no drafting rolls. The laps, consisting of 24 or more separate slivers wound on a lap rod, are taken direct from the waste cards and laid on the back of the machine, whence they run under one self-weighted roller direct to the spindles. The speed of spindles is necessarily varied according to the strength and quality of the material supplied.

The production depends so much on the mixing and kinds of waste used that figures as to this have small value. The wages also vary at each mill. At a waste mill I visited at Zittau, in Saxony, I found that they used mostly sweepings, card fly, and similar material and mixed in some white waste from a wadding mill to bring up the color. The mules used were 500 spindles each, and on No. 6s waste yarn they were doffed about six times a day, getting 26½ to 33 pounds at a doff or 176 to 198 pounds a day. For every 500 spindles there were required one spinner, one piecer, and one creeler. The spinner was paid on No. 6s 86 cents per 200 pounds, the piecer received 70 per cent as much, and the creeler 50 per cent as much. The spinner therefore made about 78 cents a day, the piecer 54 cents, and the creeler 40 cents. This was on low-grade waste. In most of the mills I found that there were used a piecer and creeler to every 500 spindles, but that the spinner looked after three to four mules, usually about 1,500 spindles. Few of the mules for waste spinning are made over 500 spindles, and 330 spindles seem to be a common size. In many places the operatives are paid by the day or by the hour, and this is probably due to the impossibility of paying by production where many different kinds of mixings are used. Most of the vigogne (the imitation yarn vigogne) mills pay by the hour and the spinner gets 95 cents to $1.19 a day, and the others in proportion. At one mill at Crimmitschau, where there are many vigogne yarn mills, one manufacturer gave me his prices as being 30 pfennigs an hour for the spinner (71 cents a day), while the girls who acted as piecer and creeler got only 20 and 15 pfennigs an hour (48 and 36 cents a day, respectively), but this is a little lower than usual.

Prices paid for reeling vary, but for No. 6s cotton-waste yarn the usual price is one pfennig per English pound. [Pictures of all the machines mentioned in the foregoing part of the report and samples of various textile fabrics made from cotton waste and linters are filed for inspection by the textile trade at Bureau of Manufactures.]

A NEW RING SPINNING FRAME FOR COTTON WASTE.

Cotton waste is usually spun on the mule because the material consists of short and uneven length fibers and could not be spun on the ring frame without excessive twist. To spin on the mules, however, is more expensive than to spin on the ring frame, and there have been many efforts made to adapt the ring frame to fulfill the functions of a mule and yet retain its cheapness of operation. One such

adaptation of the ring frame has been patented by a firm at Gebweiler, in Alsace, and is being introduced into the cotton-waste mills. In one mill where I saw this machine in operation the manufacturer was enthusiastic as to its merits. The special advantage of this machine is that it makes a cleaner and more even yarn than the ordinary ring frame and permits of a higher draft. It can not take the place of the mule for very soft spun yarns, but for many purposes, especially for making warp yarns to be used in scouring cloths, carpets, etc., the yarn from this machine is as good as that obtained from the mule, and at much less cost.

This machine is made in two styles. The first is shown in fig. 1, with a detail view of the rolls and the roller stand in fig. 2. This

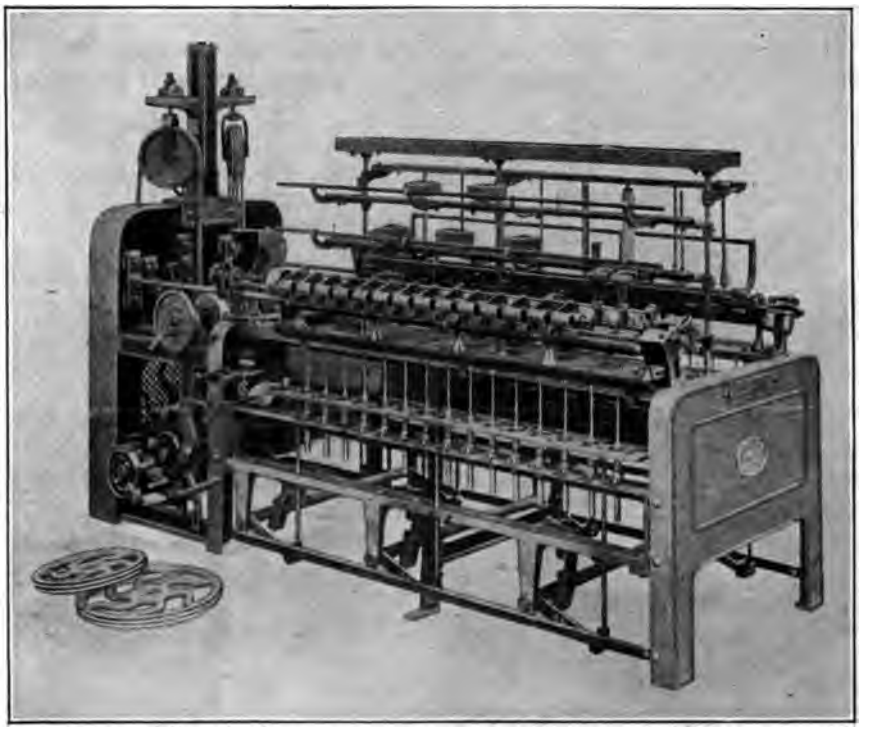

FIG. 1. Ring spinning frame with drawing.

differs mainly from the ordinary frame in the introduction of a "nadelwalze" or needle roller between the middle and front roller and this parallels and cleans the yarn as it is being drafted. The second style is shown in fig. 3 where, in addition to the last-named system, patented by Perrin, there is added an intermittent second draft arrangement that is patented by Meyer.

The maker calls this a "Ringspinnmaschine mit Streckwerk," that is, a "Ring spinning frame with drawing." He claims that all mixtures of textiles, such as cotton, wool, or silk waste, noils or short fibers of ramie or jute, etc., can be spun on this machine and that the resulting yarn is equal to any made on the mule. With Louisiana cotton the arrangement of the rolls permits a draft up to 16s for

single roving. Nos. 25s to 28s yarn can be spun direct from No. 1.8 hank rove, and in consequence of such arrangement one process of fly frames can be omitted and the production of the cards be much increased. The yarns are much cleaner than if made on a regular spinning frame, owing to the cleaning action of the needle roller. This roller does not lap up and needs no cleaning.

MECHANISM OF ROLLERS.

On this machine, with the arrangement shown in fig. 3, the first draft is made between the fluted roll A with its pressing roll A′ and the stretching roll 3, with its pressing roll 3, and between these two is the needle roller H. A second draft operating similarly to the carriage draft on a mule is produced in the following way: Between the stretching roller 3 and the spindle 7 there is a revolving through-going roller provided with two cam-like projections 4, which serve to move up and down on each revolution of the roller the press-

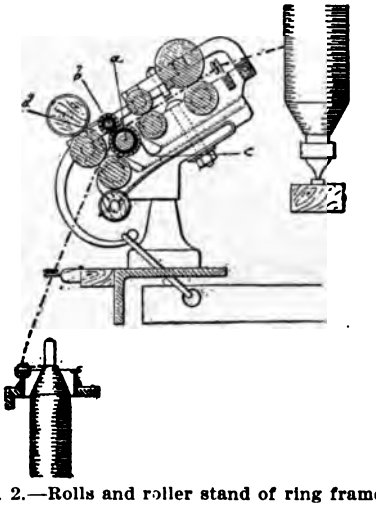

FIG. 2.—Rolls and roller stand of ring frame.

ing roll 2. When this roll is up the twist is specially transferred to the thin place in the yarn shown by the figure 9. When, however, the pressing roll is on the roller 1 then the latter develops a draft between it and the stretching roller 3. This draft affects especially the thicker places shown by the figure 8, where there is less twist than at the places 9, so these thicker places are twisted together and the yarn becomes uniform. As the two drafts are multiplied by each other a considerably higher total draft is thereby obtained than on any other spinning frame.

The maker claims for this machine the following advantages over the mule: (1) The manufacture of strong cops up to 8.5 inches length, and about 1.50 inches diameter; (2) large draft whereby the roving can be made heavier and a larger production thereby obtained on the card; (3) uniformly regular draft as the fibers, whether long or short, are guided and kept together by the wires of the small needle roller shown as *a* in fig. 3; (4) regulation of the drafting accord-

ing to the length of the fibers; (5) the production of one of these ring frames of 200 spindles is equal to that of a mule with 330 spindles and occupies only one-fourth the floor space; (6) the labor cost is much cheaper, as to attend a ring frame of 280 spindles there is only required two girls; (7) the consumption of power by the frame is nearly 30 per cent less than that of the mule.

As used in the waste mills this frame is creeled with cheeses or sections of single ends taken direct from the waste card. One such cheese is shown at *M* in fig. 3.

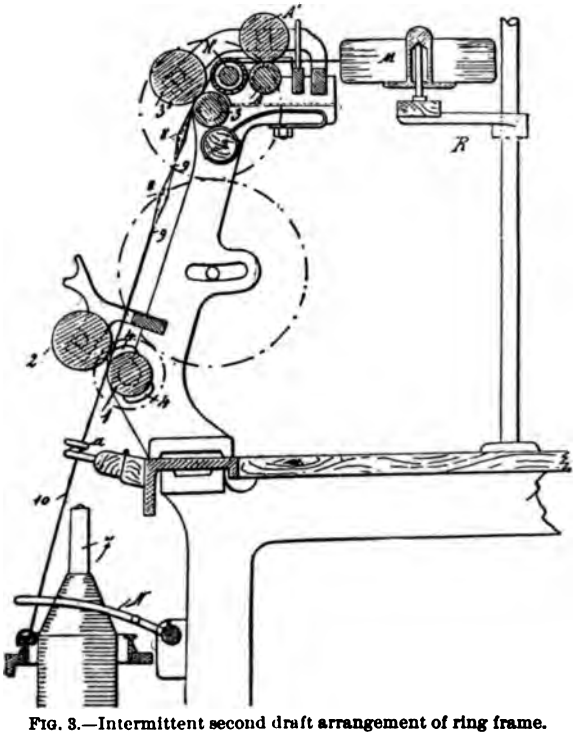

FIG. 3.—Intermittent second draft arrangement of ring frame.

The present price of this 280-spindle frame, with 100 mm. (3.94 inches) gage, is $1,904, with extra 6 per cent for sea packing.

TUBULAR COP MACHINE.

The tubular cop machine, called in Germany a "Schlauchkops-Spinnmaschine," is a machine that is used for making coarse yarns from cotton waste, cotton, wool, hair, etc., and obviates the necessity of using the expensive self-actor.

Like the ring spinning frame for cotton waste, previously described, this machine spins direct from the waste card without intermediate process, but the product of this machine is cops for immediate use in shuttles in weaving carpets, scouring cloths, etc., while the product of the other was warp yarns.

Figs. 4, 5, 6, and 7 are taken from the catalogue of a Chemnitz manufacturer, the first showing the complete machine. The operation is as follows: The single roving cheeses from the waste cards

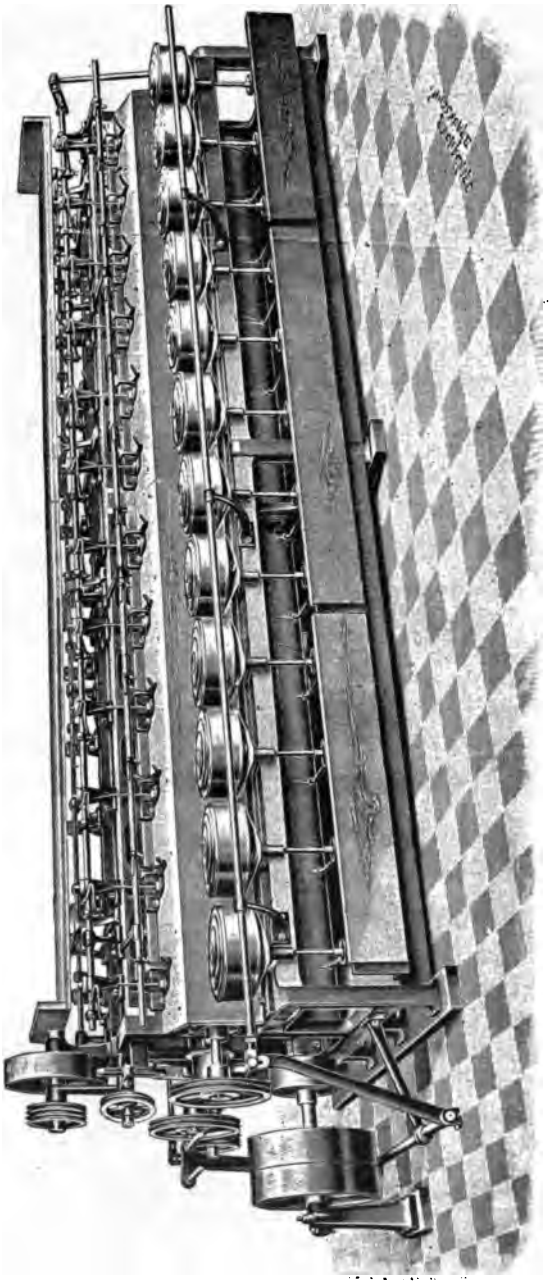

FIG. 4.—Tubular cop machine.

are laid in the round metal cans shown as *K* in fig. 5. The lids of these cans can be lifted, and are made fast to the can simply by pressing down. The inner end of the roving is drawn from the cheese

that has been placed in the can, through the hole in the middle of the can lid, and is led upward over a roller, through a swinging thread guide *f*, to the funnel in which the yarn is to wind itself in cone shape. The tin cans *K* are fastened on vertical spindles, which are put into rapid revolution by belt from the drum under the machine. In this way the roving that is being drawn out of the tin cans gets the necessary twist. The spindles are four cornered and are driven by means of small bevel gears on a horizontal side shaft. As the cop grows it is steadily lifted higher out of the funnel which forms the cop shape, and when the cop has reached full size the spindle is automatically stopped. Each can and the spindle can be placed in or

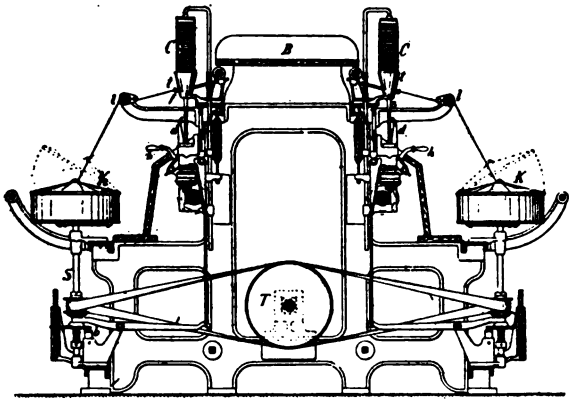

FIG. 5.

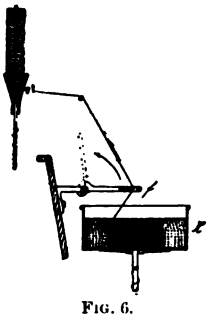

FIG. 6.

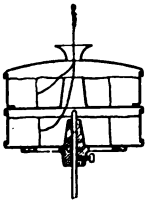

FIG. 7.

Details of operations of tubular cop machine.

out of position by a disengaging apparatus separately of the others. The brake *d* holds the spindle when disengaging, so that the thread does not get more twist owing to the can continuing to run. By pressing on the lever *h* each can is placed in position with the spindle, and by lifting the lever the cans come immediately to a stop.

VARIATIONS IN TYPES—COST OF VERDAU MACHINE.

The roving cans are sometimes used without lids, as shown in figure 6, where the roving cheeses work separately. In this case the yarn is drawn through a movable thread guide. The tubular cop machine can also be used for twisting, when spinning, by means of a double can, as shown in fig. 7. The cans themselves can be made in many different shapes, and the firm in Chemnitz has patented a number of such makes for different purposes. The swinging of the thread guide

can be arranged to give any desired crossing of the yarn; the yarn can be spun with right or left hand twist, and by choosing funnels that have been slitted in the proper manner the cop can be wound either right or left handed. Finished cops are laid on the top of the machine. All movable parts of the machine are sheltered from dirt and from contact with the working girls by removable covers. The machine is usually made with cans on both sides, but is sometimes made one sided, so as to be placed against the wall. The usual spindle gage is 333 millimeters (about 13⅛ inches), so that large cheeses of 300 millimeters (11.8 inches) diameter can be used in the cans and the loss of time occasioned by frequent replenishing with smaller cheeses avoided. The width of such a machine as made by the Chemnitz manufacturer is 1,800 millimeters (about 71 inches), and the length is equal to the number of spindles on a side. For yarns to be spun finer than No. 1 English—that is to say, for Nos. 3 or 4—cans of about 200 millimeters (7.8 inches) diameter and narrower spindle gage are substituted. The power required is about one horsepower per 25 spindles. On No. 1 yarn the production per spindle is about 12 pounds per day of eleven hours, and one girl runs 12 spindles.

A firm at Verdau, Saxony, gives the cost of a 60-spindle tubular cop machine at $952, to which has to be added 10 per cent for sea-packing charges. Such a machine is stated by this firm to give a production of 770 pounds of yarn per ten-hour day, with 6 female operatives, and to be the correct number of spindles to handle the delivery from a double waste card making 4 laps of 80 threads each.

Tubular cops can be made on these machines up to 60 millimeters (2.36 inches) diameter and up to 300 millimeters (11.8 inches) in length. These tubular cops are firmly made and when placed in the shuttle require no spindle, as the cop entirely fills the shuttle, and the thread is drawn out from the inside.

THE COILER SYSTEM.

As has been shown in the foregoing, the condenser system of waste manufacture uses an opener, picker, automatic double or triple card set with hopper feed, and mule. The coiler system is not adopted as much as the condenser system in Germany, but the machines used are as follows: (1) Opener; (2) picker with lap-making apparatus; (3) breaker card with 1, 2, 3, or 4 cans; (4) doubler and lapper; (5) roving card; (6) mule.

In this system there is interposed between the two cards a doubler. This machine takes the slivers from some 40-card cans ranged on either side and rolls them up into a narrow compact lap. The breaker card can be made as desired to coil into 1, 2, 3, or 4 cans, and these are the ones that go to the doubler, which will take the production of 8 to 10 breaker cards. The lap as made on the doubler is usually one-half the width of the roving card, and two are placed together on a lap rod. Very often to secure still more uniform results four of these laps, forming two card laps, are placed behind the roving card. The laps as made on this card go to the mule as in the other system.

The coiler system has the advantage of the condenser system in that there is more doubling of slivers, and therefore the resulting yarn is evener in grade, and it also has the advantage that any card can be stopped for repairs or cleaning separately. It has the disadvantage, however, of introducing another machine, which adds to the cost of manufacture.

EMBROIDERIES AND LACES.

BARMEN DISTRICT.

DETAILS AND VALUE OF OUTPUT OF BRAIDED GOODS—VARIETY OF STYLES AND PATTERNS MANUFACTURED.

Cotton manufacturing, with its many ramifications and special branches, is probably the world's greatest industry. In Germany each special branch tends to concentrate in some particular section and around some particular town. Thus Chemnitz is known for hosiery, Plauen for embroidered laces, Gera for fine dress goods, Crimmitzschau for vigogne yarn, Augsburg for fine spinning, Mulhausen for fine weaving, Elberfeld for colored goods, Crefeld for velvets, etc. The specialty of Barmen, in western Germany, and one that has caused it to be a familiar household word around the world, is braided work, and particularly that branch of braided work known as "Barmen laces."

There are in and around this town some 80,000 braiding machines, with probably 3,000,000 braiding spindles. Of these machines it is estimated that between 8,000 and 10,000 are devoted to the specialty of Barmen lace.

EXPORTS OF SPECIALTIES TO THE UNITED STATES.

In regard to the total production there are no official figures, obtainable, but leading manufacturers estimate the export of lace from Barmen as being about 10,000,000 marks (mark=23.8 cents) a year, and that this is only one-third of the total production. The only trustworthy figures in regard to the exports are those of the American consulate showing the exports to the United States.

Considering only work made on braiding machines and ribbon looms and the additional exports of polished "iron" yarn (the latter because sent to the United States to be used in braided work), the exports of these specialties from Barmen for the last five years have been as follows:

Specialties.	1903.	1904.	1905.	1906.	1907.
Barmen lace (torchon)	$146,727	$159,912	$204,704	$237,072	$342,382
Laces, cotton, and other materials	154,367	143,728	212,772	202,300	244,391
Hat braids	167,552	225,124	207,941	240,975	175,654
Hatbands and ribbons	1,202,685	583,100	689,200	915,800	990,900
Galloons, trimmings, and edgings	190,995	158,437	155,152	280,126	361,863
Braids (featherstitch and Battenberg), etc.	423,068	362,807	333,747	347,694	320,727
Iron yarn	116,572	153,510	172,740	184,164	205,136
Total	2,401,966	1,786,618	1,976,256	2,408,131	2,641,053

It will be seen that though the shipments of some specialties have declined, that of Barmen laces has steadily increased from $146,727 in 1903 to $342,382 in 1907, and this in spite of the tariff and the fact that Barmen laces are being manufactured in the United States in increasing quantities. The wages paid in Barmen are lower than in the United States. The manufacturers here do not attempt to run on standard articles as much as is done in America, but keep a large force of designers who are alert to invent new designs and to catch every passing whim of the market. These designers are thoroughly trained in the excellent German technical schools, and are always hard at work to keep just a step ahead of their competitors.

ORIGIN AND GROWTH OF THE INDUSTRY.

"Barmen laces" are now made in many countries, notably Belgium, but they were originated at Barmen, and this place was the first to use both the hand and the machine in this work. The first machine to make this specialty in other countries seems to have been one patented at Manchester, England, in 1748, but the making of Barmen laces had been a well-established industry at Barmen long before this period. The industry was established in the United States by men from Barmen and is to a certain extent still carried on by them.

In ordinary weaving there are used two sets of threads, one the warp and the other the filling. In braiding there is used only one set of threads, and these are plaited together to form the design desired. In the making of braids these threads are plaited or braided together in many different ways, so that every thread plaits with every other thread, groups of threads combine with each other, braids join with other braids, or parts of braids plait with parts of other braids, the latter forming the laces.

Barmen lace is really a fancy braid, and is made on a machine that is simply an improved braiding machine. The system of all these braiding machines is that of the "Maypole," and the main principles may be fixed in the mind by a description of Maypole dances.

PRINCIPLES INVOLVED IN MAKING BARMEN LACE.

Suppose there are a number of dancers around a Maypole—say, 16—each holding an end of a ribbon of which the other end is fastened to the top of the pole. Suppose, first, that the 16 dancers are divided into two parties of 8 each, and that each party dances around the pole in an opposite direction, each group following the path of its leader and taking a serpentine course so that every dancer goes to the right and then to the left of alternate dancers of the other party going in the opposite direction. There will be formed at the top of the pole a "round" braid or cord.

Suppose, second, the same conditions as before, but that instead of continuously circling the pole in the same direction the leader of each party, on the completion of a circuit around the pole, passes completely around the last member of the opposite party and goes back to the starting point. In doing so he follows the serpentine course traced by the opposite party—that is, he follows the reverse semicir-

cles to his own course in advancing. There will be formed at the top of the pole a "flat" braid.

Suppose, third, that the 16 dancers do not circle the pole completely, but are divided into four parties of 4 each, and that each four dancers interweave among themselves on their own special arc of the circle. Where their course laps that of the adjoining group each dancer passes around one dancer of the adjoining group, but otherwise they interweave only among themselves. There will be formed at the top of the Maypole a "stripe" braid.

Suppose, fourth, that the dancers are divided into four groups of 4, each interweaving on their own particular arc of the circle, and that in this case their course does not overlap that of any of their neighbors. They interweave among themselves, but at regular or irregular intervals, at the direction of the leader, one dancer changes places with one dancer from a neighboring group, weaves a figure with them, and then returns to his own group. There will be formed at the top of the pole a "Barmen lace" braid.

In the machine the place of the top of the Maypole is taken by the suspended eye of a "braid former," which collects all the threads into one hole, the places of the dancers are taken by bobbins of thread held by "bobbin carriers," and for the tracks of the dancers are substituted grooves cut in a steel plate.

OPERATION AND UTILITY OF THE MACHINES.

Fig. 8 shows the types of grooves used for making each of the four styles of braids mentioned. Fig. 8A shows that the two sets of carriers going in opposite directions cross at regular intervals in their serpentine courses, but that each set has its own track, never gets on that of the other, and never changes the direction of its circling. Four bobbins is the least number that can be used to make this type of braid. Four bobbins make a square braid, six a hexagonal, eight an octagonal, etc., the larger the number the more nearly approaching a complete circle being the resulting cord.

Besides cords, this machine is also used for making steam and water packings, and in this case there is usually an extra "core" of rubber or some other material run up through the middle of the machine around which the threads interlace. In cases where it is desired to use a core of asbestos or other loose material the material is placed in a funnel over the top of the braid former and part of the carriers placed so as to run upside down. In covering whips, telephone wires, etc., the machine is frequently turned on its side so that the core is fed through horizontally. For covering heavy cables there are often three vertical machines arranged one above the other. There is an infinite number of combinations and arrangements of machines of this type for making cords, tubular braids, etc., or for covering work.

VARIOUS STYLES OF FLAT BRAID MANUFACTURED.

In fig. 8B it will be seen that each set of carriers makes a circle around the circumference of the machine and then reverses and returns to its starting point on the grooves previously used by the other set. As in the first case, the carriers do not interweave among themselves, but only with the carriers of the opposite set. Braid of this kind—flat braid—can be made with as few as three carriers. It is therefore the simplest braid that can be made, as two threads can not be braided, but only twisted around each other. To make this braid it is necessary to have an odd number of spools—3, 5, 7, 9, etc.—and flat braid thus made is usually called "soutache" braid. A soutache

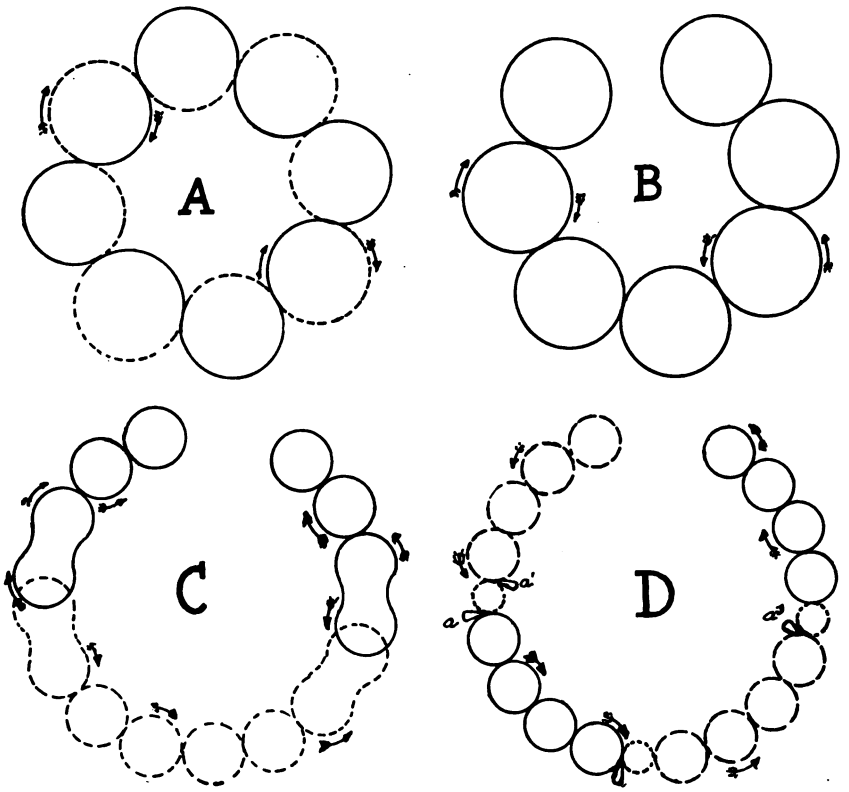

FIG. 8.—Guide grooves for (A) round braid, (B) flat braid, (C) stripe braid, and (D) Barmen lace.

braid made with three threads is called a "plain" flat braid, and every thread passes under and over every other thread.

If a soutache braid is made with five spools—in which case each thread passes alternately under and over two threads—it is called a "basket" or "diamond" braid; if made with seven threads—each thread passing alternately over and under three threads—it is called a "Hercules" braid. Flat braids are used for many purposes, but especially for passementerie and dress edgings or ornamentation.

By varying the tension exerted on different threads there can be made wave braids, rickracks, etc., and these can be ornamented with loops, in a manner to be described later, or in other ways, so that

there are many special articles made of this type of work.[a] A combination of the round and the flat braid types makes the "cord-edge braid," which consists of a cord running down the middle of a flat braid. This is much used for covering the edges of jackets, etc., the two flat parts being folded back on the upper and lower sides of the cloth and leaving the cord covering the edge.

STRIPE BRAIDS AND BARMEN LACES.

Fig. 8C shows the guide grooves for making stripe braid. These are so arranged that each set travels exclusively on its own track on its own particular arc of the circumference of the machine, but each track overlaps that of its neighbor, so that the threads carried by the bobbins of one set twist at regular intervals around the threads carried by the bobbins of the neighboring set. The bobbins of each set weave a braid among themselves, the overlapping being arranged only for the purpose of joining these separate braids together. This is the reason that the combined braids are known as a stripe braid. The separate stripes may be of different colors or materials. It is not necessary that each set shall have the same number of bobbins, and, in fact, it is usually otherwise. For instance, one of the regular staple articles in this line is made with 66 bobbins, arranged on a machine with five tracks, carrying 12, 9, 24, 9, and 12 threads each, respectively. A simpler design is made with 40 bobbins arranged on three courses of 12, 16, and 12 bobbins, respectively. Each top plate has to be grooved with reference to the number and combination of spools it is desired to employ.

Fig. 8D shows the guide grooves used for making Barmen lace. Each group interweaves on its own course, and, as these do not overlap, the bobbins, if the switches at *a*, *a'*, etc., are closed, do not mingle with any outside bobbins. The switches are made of small tongues of steel plate, and some are pivoted loosely so as to open to any carrier coming in the right direction, say one returning to its own group, while others are controlled so as to permit passage only when moved by special mechanism, and this opening may be at regular or irregular intervals, as desired.

CONSTRUCTION AND OPERATION OF THE MACHINES.

Fig. 9 shows the regular style of machines now used at Barmen for making Barmen lace. This particular machine is described as a "2 fadige, 24 litzen Spitzenmaschine mit Jacquardmaschinen"—that is, a 2-thread, 24-track lace machine with Jacquard attachment. There are 24 tracks, and 2 bobbins are operated on each track, so the resulting lace has 48 threads. A view of the top plate, showing the guide grooves used on this machine, is shown in fig. 10. Using these two illustrations, I will explain the main points of construction and operation of such machines.

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[a] By letting some of the carriers run empty, open-work braids can be produced. This method is extensively used for making hat forms out of glazed or "iron" yarn, and in 1907 Barmen, as shown in table, shipped to the United States $175,654 of this one specialty.

The body of such machines consists of two steel plates, which are circular in shape, except where extended for the purpose of attaching the take-off mechanism and the Jacquard attachment. The plates are

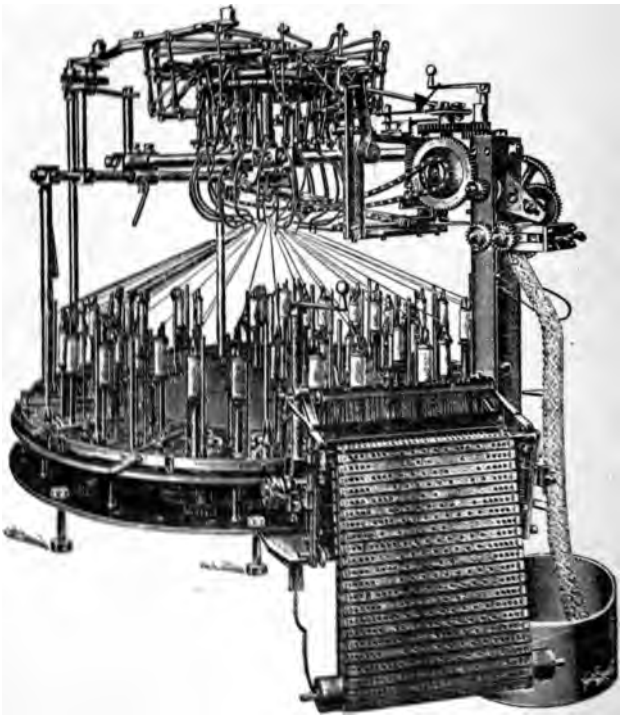


FIG. 9.—Regular style of machine used in making Barmen lace.

held one above the other at a distance of 4 inches by means of stay bolts. Between the two plates are arranged the gearing for driving the bobbin carriers. The bottom or bed plate holds the stud bolts, on

[illegible] The top plate has guide grooves [illegible] according to the type of braid to be made, and these grooves [illegible] the course of the bobbin carriers.

THE BOBBIN CARRIERS AND THEIR ATTACHMENTS.

The "bobbin carriers" are really the most important part of the machine, and will next be described with their attachments. The thread is wound on bobbins or spools, which may be of different sizes or shapes, as desired. The usual type is a double-headed bobbin with a 4-inch traverse and a diameter, when full, of 1⅜ inches. Two threads are usually wound on each bobbin together, but there may be one only or there may be three, four, or more, according to the kind of lace to be made. The bobbin carriers may be arranged to carry the spools either horizontally or vertically. The horizontal arrangement permits of the thread being drawn off more evenly with less liability of kinking, but takes up more room, so is not used except for special purposes. The bobbins have round bores and are slid on the spindle of the bobbin carriers so as to permit of turning easily. The ordinary spindle is made in the shape of a hollow square with rounded edges, being of pressed steel bent and brazed together.

A vertical bobbin holder of the ordinary type used at Barmen is shown in fig. 11. The small foot plates *b* and *b′* of this bobbin carrier are separated from each other a distance equal to the thickness of the top plate by the small vertical bar *c*. This bar is a short straight piece with rounded ends and slides in the guide grooves. The foot plates *b* and *b′*, being above and below the top plate of the machine. keep the bobbin carrier vertical.

The pin *a* at the bottom of the bobbin carrier rests in a notch of the horn gear below and the revolution of the horn gear therefore moves the bobbin holder. These "horn gears" are made with double flanges. The lower flange has cut in its circumference ordinary spur teeth and is revolved by means of other gears which transmit to it power from the driving belt. The upper flange is cut with notches and horns, and the number of these notches varies according to the class of machine and the position of the gear on the machine. These upper flanges work close together, so that one is beveled on the lower edge and one on the upper edge.

THE TENSION AND AUTOMATIC STOPPING DEVICES.

Every bobbin carrier has a device for regulating the tension of the thread being drawn off and also an arrangement for automatically stopping the machine when a thread breaks or runs out. The stop-motion arrangement consists of a small piece that slides up and down on the standard. This is shown as *d* in fig. 11. When in operation the thread passing through the eye in the top of the piece *d* holds it up, but when the thread breaks or runs out this piece falls and a projection at its bottom strikes against a lever on the top plate and this, through the usual connections, stops the machine. For large machines there are usually four or six of these levers arranged at various points on the top plate, so that the machine is quickly stopped when the bobbin carrier with a fallen stop-motion weight reaches this point.

The tension device consists of a weight hung on the thread, and this weight may be hung inside the hollow spindle of the carrier or may slide up and down on the top part of the carrier outside. Fig. 11 illustrates the first and fig. 12 the latter. The weight is usually hung inside, as the centrifugal force of a rapidly revolving carrier

tends to prevent an outside carrier dropping quickly enough to prevent kinking when the thread slackens. The weight is thus also more protected from dirt, but this arrangement makes the threading somewhat more troublesome.

Fig. 11 shows a carrier without bobbin, but when a bobbin is placed on it the thread is first run through the eye near the center of the standard, then through the stop-motion eye, then up through the eye at the top of the standard, down through an eye in the lever *e*, through the tension-weight eye, and then through the eye at the top of the hollow spindle, whence it goes to the braid former. This makes a total of six eyes to be threaded. On both styles the short lever at the top is arranged so as to be lifted clear of notches in the top of the spool by the tension of the thread, but when this tension ceases the lever drops into a notch and prevents the bobbin continuing to unwind.

FIG. 11.

FIG. 12.

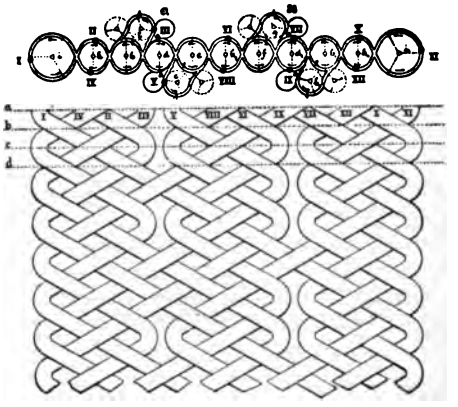


FIG. 13.

FIG. 11.—Vertical bobbin holder. FIG. 12.—Bobbin carrier, showing the outside tension weight. FIG. 13.—Courses of bobbins in making three-line lace.

VARIATIONS REQUIRED FOR THE VARIOUS WEAVES.

For making ordinary braid two gears are of course the least possible number that can be used. On large lace machines there may be as many as 60. In making the simple "soutache" braid previously noted the horn gears at the end are always made with an odd number of teeth and the middle gears with an even number of teeth. The reason for this is readily seen, as the end gears have to carry each bobbin completely around and start it in between two other bobbins on its return course. The end gears, having a tooth more than the middle gears, also incidentally tend to make a better selvage.

For plain soutache braids the end gears usually have five horns and the middle gears four. For diamond pattern flat braid the end gears may have three horns and the middle gears two, but as ordinarily produced this braid is made with two threads instead of one, in which case they have six and four horns, respectively. For Hercules flat braid the end gears have seven horns and the middle gears six.

In making round braid there is no reversing, and as each bobbin repeats continually the same course, the gears all have the same number of horns and these are made of an even number. Barmen laces

are made in three styles, either two, three, or four threads to a "Litzen" or course, so the horn gears for this work are made with four, six, or eight horns, according to which is desired. There must always be at least double as many horns as there are bobbins, so that each bobbin carrier pin in shifting from one gear to another will find a vacant notch ready for occupation.

The total number of bobbins for making Barmen lace simply depends on the design and the size in which the machine may be built. Of the four-thread Barmen laces the highest number of separate "Litzen" or tracks at present used on machines here is 24, which gives a 96-thread lace. The largest two-thread machines have 60 separate tracks or courses, or a total of 120 threads braiding together. Laces up to 10 inches wide can be made on such machines. These are the largest Barmen lace machines built. They have a diameter of 3 meters (meter=39.37 inches) and cost 3,000 marks ($714) each, but there are only six as large as this as yet used at Barmen.

MODIFICATIONS NECESSARY FOR MAKING THREE-LINE LACE.

As the tracks on a Barmen lace machine do not overlap each other and are separated by switches, the horn gears at the ends of the courses do not meet and special horn gears have to be employed in addition to the regular ones. This is clear from the fact that the grooves in the top plate of the machines follow very nearly the pitch line of the gears underneath. In fig. 13 will be seen—projected on a straight line for convenience in explaining—the grooves that are used around the circumference of a Barmen lace machine for making a particular lace. This lace is called a three-line four-thread Barmen lace. It is made with 12 threads, and dots marked I to XII in the figure show the position of the 12 bobbins at the commencement of the lace figure on line *a*. It is seen that there are three separate courses, consisting of four separate circles for the two outer courses and five for the inner. The two circles in between are courses that are occupied only when the switches are open and at other times they and the auxiliary horn gears outside run empty. The lace is called three-line, because there are three distinct stripes and these interlace only at intervals, the first being when bobbin No. I and bobbin No. IX change places. The method of interlacing is shown so clearly by the diagram as to need no explanation.

THE BRAID FORMER AND TAKE-OFF ROLLERS.

The threads collect as braided together at the braid former above the center of the machine and the finished braid is drawn off by the take-up rollers clear of the machine and falls into a can placed alongside. The braid former consists of an eye, which may be of any shape desired. For heavy or complicated work it is necessary that the braid forming shall be assisted by some device to beat up the threads and compact them in a fashion similar to the beating-up work done by the forward action of the lay in the ordinary loom. For some styles of braids this is performed by means of two combs on long arms which swing in toward the braid former along the course of the forming braid. In others there are arranged above the braid former an eccentric arrangement with pivoted arms, and these arms hold curved wires which swing in radially toward the braid former

and beat up the interlacing threads. This arrangement is shown complete in fig. 9.

The take-up motion consists of three rollers which draw off the finished braid. Their speed can be regulated by change gears and their distance apart adjusted according to the thickness of the braid. Some are arranged so that only one roller is fixed and the others held in position by springs. For braided work of irregular shapes calender rollers are dispensed with and the material drawn off by the friction of one or two wrappings around a large wheel, which may have grooves cut in it. For very irregular shapes the material has to be drawn off by hand.

ATTACHMENTS FOR WEAVING SPECIALTIES.

For special effects Barmen lace machines are made with other attachments and special arrangements. One arrangement consists of introducing extra threads from an outside source for making a core, around which the regular threads from the carriers interweave. Such extra threads are called distinctively "warp threads," and are usually drawn from stationary bobbins placed on the floor under the machine and drawn up through hollow bolts into the braid being formed by a set of interlacing bobbins.

Another arrangement for producing specialties consists, as previously stated, in varying the tension of the threads by means of hanging weights of different sizes on particular threads. This prevents the braid running in a straight line and produces wave and other similar effects.

Another special device is that for making loops. There are several patented arrangements for this, but the principle used in all is that of a straight wire pointing from a certain place just over the tops of the revolving bobbin carriers toward the braid former. The threads pass under it to the braid former without being affected, but at intervals the outer end drops momentarily on to the top of a carrier spindle, when the thread of that bobbin passes over the wire and is thereby caused to make a loop. The carriers are usually so arranged that part of them have projections at the top to strike and pull down this wire for the second that they meet, while the other carriers, being without these projecting collars, pass under without being touched.

REGULATION OF THE PATTERN—THE JACQUARD SYSTEM.

It has been previously shown that on Barmen lace machines the bobbins from the separate braids being made only interweave when the switches between the separate courses are open. The pattern therefore depends on the order in which these switches are opened and closed. There are three separate methods of accomplishing this. The oldest and simplest plan is to fasten vertical pins in the switch tongues and then provide special bobbin carriers with projecting collars which will strike these pins and open and close the switches either for their own passage or that of a succeeding carrier without collar. This arrangement permits of only short patterns and is now little used except for special purposes.

The second system consists of a series of notched disks revolving on a horizontal shaft at the side of the machine. The notches correspond to the distances of the carriers on the machine, and movable

fingers are attached to each disk and can be clamped into any notch as desired, and each finger on striking against the lever pin below causes the connecting lever to open or close the particular switch to which it is attached. This system also does not permit of sufficient variety, and while there are a good many machines of this type at Barmen they are nearly all old machines, and the new machines have the Jacquard arrangement, which is shown in fig. 9. It is seen that in this third method the pattern is fixed by means of the perforated pasteboard cards running over the revolving square of an ordinary Jacquard, so that where there is a hole in the card a needle swings in and its connecting lever moves a particular switch and where there is no hole met the needle can not shift the switch. The patterns are stamped on punching machines exactly the same as for the ordinary loom Jacquard work.

ARRANGEMENT AND SPEED OF THE MACHINES.

Large lace machines are mounted on separate tables with separate belts, but the majority of the machines at Barmen are mounted in sets of 10, there being 5 on each side of a short central shaft driven from a belt at the end. This central shaft carries bevel wheels, which gear with horizontal bevel wheels, and thence transmit the power through spur gearing to the carriers and take-up attachment of each machine. Between each separate machine and the bevel gears are often interposed clutch gears, so that any particular machine can be thrown out of gear without stopping the others.

The shaft of the braiding machines is usually run at about 75 revolutions per minute, and the speed of the ordinary braiding machines is given by manufacturers as from 180 to 250 turns of the handle per minute. This is a wide range, but the range of the work is equally wide, and the speed is varied not only according to the complexity of the particular design, but also according to the skill of the operator. The speed of each machine or set of machines can be quickly changed by means of change gears. These machines are arranged so that one turn of the handle—this handle may be seen in fig. 9, and is for the purpose of turning the machine backward or forward by hand—is made while two carriers are passing any particular point on the guide grooves. There are, therefore, two interlacings, corresponding to two "picks" of a loom, made for each handle turn, and the number of crossings will usually be two times 200 or 400 a minute. For Barmen laces the speed is slower and is usually given in Jacquard movements per minute instead of handle turns per minute. The speed here also depends on the design, the workman, and the strength of the material, and is given by manufacturers as ordinarily ranging between 120 and 170 Jacquard movements per minute. By this is meant that 120 to 170 Jacquard cards are presented to the needles every minute.

YARN SPOOLING—FINISHING AND PACKING LACES.

The lace factories buy their yarn from spinners, some of it being imported. This is usually in skeins and is then wound on the spools or bobbins of the particular size and shape required. Some factories let this work out to home workers, who do nothing else. There are 36 such establishments in Barmen, employing 280 operatives, who

do only this spooling for the factories. In some of these places the work is done by power and in others by hand. In the regular factories I also noticed men operating handwheels, but this is usually for spooling on bobbins of special sizes or sizes needed in limited numbers.

After manufacturing some braids and laces are considered complete, but the majority of them are run through a small calendering machine to finish and in some cases to size. The machine is made so that the laces first pass over live steam to soften them and then through the ordinary steam-filled calender rolls. They then go to the shipping room, where they are inspected, wound on cardboard, cut up into the required lengths, ticketed, wrapped, put in cardboard boxes, and these cased. The cardboard on which the laces are wound is held between two flat-slit clutches and then revolved by hand until the desired length is wound on, when the roll is taken off and a new piece of cardboard inserted.

PRICE OF MACHINES—WAGES AND HOURS OF OPERATIVES.

The price of Barmen machines varies greatly according to the number of spools, the number of tracks, the particular attachments desired, etc. One manufacturer stated that his charges were based on 55 marks (mark=23.8 cents) per Litzen or track, while another gave his prices as ranging from 420 marks for a 6-litzen lace machine to 3,000 marks for a 60-litzen lace machine with 2 threads to a litzen. The price may therefore be figured as about $12 per track, or $288 for the ordinary 24-track lace machine.

For ordinary work at Barmen one operative, either man or woman, runs one set of 10 heads, and makes 4 marks a day or 24 marks a week. The hours vary considerably at different factories, but the usual time seems to be fifty-seven hours a week. The usual arrangement is from 7 a. m. to 12 and from 1 p. m. to 6.30, with fifteen minutes for the regular 4 o'clock stoppage and only six hours on Saturday.

In Saxony I found that the majority of the textile factories did not stop more than an hour earlier than usual on Saturdays, but around Barmen the operatives demand the Saturday afternoon and prefer to have this half holiday and make up the time during the other five days. The total hours per week are also somewhat less than in Saxony.

[One photograph showing cord-braiding machines in operation, and seven additional text figures of different parts of lace-making machines, together with eighteen samples of the various kinds and styles of braids and laces manufactured at Barmen, accompanying the foregoing report, are on file in the Bureau of Manufactures.]

PLAUEN DISTRICT.

DEVELOPMENT OF THE MANUFACTURE OF EMBROIDERED OR ETCHED LACES.

Of the many branches of cotton manufacturing, that of lace making is the most refined and artistic. The products of this branch, more than those of any other, are used for purposes of ornamentation, as distinguished from wear and durability. This is especially true of the Plauen lace, which is used almost exclusively to trim ladies' dresses and to make fancy blouses, overskirts, etc.

Of the four big European centers for lace and embroidery, Nottingham and Calais produce mainly fancy lace on the Levers lace machine. St. Gall makes little lace, but employs both the hand and the schiffli power machine for embroidering on muslin and cambric. This work is for utilitarian purposes, such as underwear, corset covers, etc. The Plauen manufacturers work on an entirely separate branch of the industry, as they use the embroidery machine for making lace. The Plauen product is known as embroidery or etched lace.

ANNUAL PRODUCTION, AND EXPORTS TO THE UNITED STATES.

The Plauen district produces annually embroidery laces to an estimated value of 70,000,000 marks (mark=23.8 cents). Of this only about one-fifth is retained for use in Germany, and the remainder is exported to other countries, especially to the United States and England. The figures for laces and embroideries shipped from Plauen to the United States in 1907 are as follows:

Laces and embroidered articles:	
Cotton	$3,211,784
Cambric	118,000
Silk	159,015
Artificial silk	84,013
Linen	29,992
Lace curtains	18,746
Torchon lace	1,353
Total	3,622,903

The total value of all exports from Plauen to the United States in 1907 was $4,479,021, so it is seen that laces and embroideries form three-fourths of the total, and the growth of this business is worthy the careful attention of American manufacturers.

HISTORY OF THE INDUSTRY.

Plauen in Vogtland, as it is known, to distinguish it from another Plauen near Dresden, is loftily situated in the southwestern section of Saxony. In ancient times it was the seat of the Vogt (Advocatus regni), and it is now the capital of the section of Saxony that is still called, as in ancient times, Vogtland. The Vogtland and the neighboring portion of southern Saxony known as the Erz-Gebirge have been centers for the textile industry for centuries.

This section is situated on the old highways of trade that ran between northern Germany and Bohemia and Bavaria, and as the soil is shallow and the people naturally a home-loving and an indoor race, they started cottage industries, especially textile industries, at an early date. This section became noted for its hand embroidery work, and the knowledge acquired in this line was handed down from father to son.

The modern work may be said to date from 1857, when the first hand machine for making embroidery was introduced from Switzerland, but it was not until 1881, when Herr Bickel, at Plauen, originated the idea of embroidering on tulle, that the specialty was started that has since made Plauen famous. The idea of embroidering on net was later followed by that of embroidering on a material to be chemically removed so as to leave only the embroidered lace itself.

DEVELOPMENT AND PRESENT CONDITIONS.

When this specialty was started there were only some 30,000 people in Plauen, but in the quarter of a century that has elapsed since then the population has more than trebled and is now given as about 110,000. This population has gathered here from all over Germany, being attracted by the higher wages. For a while this specialty was almost a monopoly of this one place and the demand was such that large profits were made. Even to-day this specialty is more developed in this one town than in any other country of the world, and through its lower wages and its highly trained personnel it is enabled to sell millions of dollars worth of these goods every year to great textile countries like England and the United States.

The profits in this business have been so good that not only were skilled and unskilled operatives attracted here from all over Germany and from other countries, but men in other lines of trade started in business on their own account. Such men would buy or rent a few machines and employ a few skilled operatives to run them. In the prosperous period they easily got orders, and starting with no knowledge of the business at all some gradually built up large firms. At the present time (March, 1908) the business is feeling the stress of hard times, and many of these immature firms that have been started in the last few years will probably go under. The financial crisis and the consequent lack of buying orders from the United States is being severely felt, and all the factories are running short time and some have closed down. Any disturbance of the buying power of the United States is felt in every textile center in Europe, and the most practical method to avoid disturbing these markets is to make such textiles at home.

Embroidery and lace making is scattered throughout the Vogtland and Erz-Gebirge, but centers around Plauen and the neighboring towns of Auerbach, Falkenstein, and Treuen. Eibenstock is also quite a center, but works on a special line.

HAND-MADE LACES AND BEAD EMBROIDERIES.

In considering lace work in the Plauen district it may be noted that lace can be made by three separate methods, being known as needle, pillow, and machine.

Needle lace is made with the needle by hand, and lace so made was called in old times "needle" or "point" lace. Pillow lace is made by interweaving by hand the various threads around pins stuck in a pillow. Machine-made lace is a quite recent development, but embraces a good many systems.

Hand embroidery is still employed in upper Vogtland, and is made with either a regular sewing needle or with the tambour needle. It is made on a cotton or linen ground. Both needle and pillow lace are occasionally to be found also, though only to a limited extent. The manufacture of hand-embroidered blouses and robes, also of the so-called "Battenberg" articles—little tapes joined together by needlework—still flourishes in this section.

Eibenstock is the largest hand-embroidery center, and has a reputation for rich designs and fancy work. To a larger extent it is noted for its bead embroideries. Polished Bohemian beads of various colors and spangle made from a mixture of gelatine and cellulose

are sewn on by hand and used to make dress trimmings, edgings, skirts, collars, belts, etc. Bead embroideries made on black tulle and beadwork formed on metal tulle also have a good sale.

There is still some hand work done at Plauen itself in embroidering colored wash articles, but this is more in the way of supplementary work, and the increasing number of women required in the schiffli factories tends to still further restrict this home work.

The great bulk of the Plauen articles are made on machines which are either worked by hand or power, the chain-stitch articles being made on the tambour machine, ordinary white embroideries on the hand-embroidery machine, and the laces on the schiffli power machines.

The chain-stitch embroideries, as made on the tambour machines, and on the lace sewing machines of varied types, are mainly used for decorative home work, such as curtains, doilies, centerpieces, etc.

The regular white embroidery in the Vogtland is mainly made on the hand-embroidery machines, and is similar to the Swiss embroidery. It is made on a permanent foundation of muslin, cambric, or nainsook. The Plauen work in this line is mainly of the cheaper varieties, for they can not compete with the Swiss manufacturers on the higher and more perfected designs. The reason for this is that this white embroidery is a secondary branch at Plauen, while at St. Gall it is the main business and has been brought to a high degree of perfection in all details of the work.

GERMAN VERSUS SWISS WORKERS AND PRODUCT.

The Swiss operative is more skilled than the German operative, and his wages in this line are smaller. From figures obtained at both centers in regard to this industry it would seem that the German worker receives the same number of marks (mark=23.8 cents) that the Swiss worker does francs (franc=19.3 cents). Another important point is that the bleaching at St. Gall gives more of a dead white bleach than does that of Plauen. The St. Gall bleacheries obtain their water from the Bodensee (Lake of Constance), while at Plauen they depend partly on wells and partly on a small river, the Weiss Elster, which is frequently muddy.

The hand machines in use at Plauen are similar to those described in my report on the Swiss industry,[a] but are usually 5 yards wide instead of 4½, as customary in Switzerland. This machine was introduced from Switzerland in 1857, and in 1863 there were 100 in operation. This number gradually increased until there were some 4,800 in 1893; since then they have not been able to stand the competition of the power machines and have decreased in numbers until they are estimated now at not much over 2,500. Each machine is estimated to produce 3,000 marks worth of embroidery a year, so their total production may be roughly figured at 7,500,000 marks. The bulk of the work in this line is for home consumption in Germany and little is exported.

THE PRODUCTION OF SCHIFFLI-MACHINE LACES.

The Plauen laces are made on the schiffli machine, and therefore, whether tulle laces, guipures, imitations of real laces, etc., are all classed as embroidery laces. The number of schiffli machines used

[a] Swiss Embroidery and Lace Industry, monograph, published by the Bureau of Manufactures, pp. 43.

at Plauen has steadily increased in the past few years and is now estimated at 7,000. Each machine is estimated to produce at least 10,000 marks of lace a year, so that the total production in this line may be figured at fully 70,000,000 marks annually.

Although this Plauen specialty was inaugurated in 1881, it only came into practical operation in 1883 through a Plauen manufacturer using a tulle foundation and making articles to imitate hand-made lace. This new lace became popular and profitable. Later the further idea was evolved of using a temporary background to be removed after the stitching was completed. For this purpose chemical cloths are used. The stitching is made on this as on an ordinary muslin background, and then acids used to dissolve the cloth and leave only the embroidered lace effects.

There are a good many patented processes, and every other manufacturer at Plauen has his favorite method. The principle of all of them, however, is that of using a chemical cloth of vegetable fibers when the embroidery thread is of animal fibers and a chemical cloth of animal fibers where the embroidery thread is of vegetable fibers. Thus, for cotton the chemical cloth is usually woven of wool, but for silk embroidering the chemical cloth is of cotton. In the former case the embroidered cloth usually passes through an acid bath, which dissolves the cloth and leaves unaffected the cotton lace. With silk or artificial silk there can be no wet treatment, hence the finished material is usually run over a gas flame and the foundation material burned off. In some cases a hot iron passed over the back of the material is sufficient to accomplish this purpose.

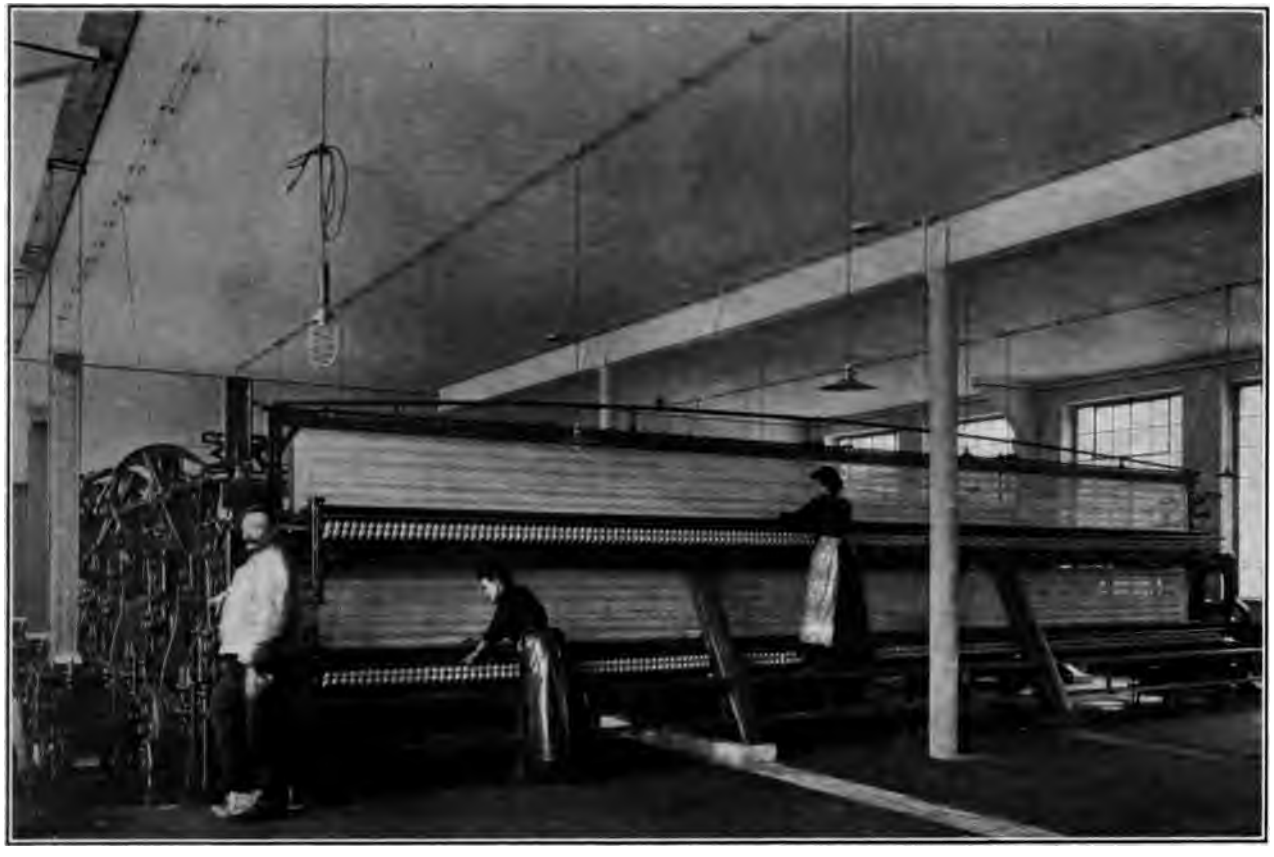
DESCRIPTION OF THE FOUNDATION MATERIALS.

Four samples of the main foundation materials used in this industry are forwarded [on file in the Bureau of Manufactures]. The principal one is a muslin, of which every two warp threads, each shedding separately, however, lie together, so that the muslin has also a rep effect. This muslin is made in England and Germany and none is made in the United States. The bulk of the Plauen demand is now supplied by Mülhausen, in Alsace-Lorraine. This muslin is usually 120 centimeters (47.25 inches) wide and has 88 warp and 84 filling threads per inch. The present price at Plauen is 66 pfennigs a meter, which is about 14.4 cents a yard, less 2 per cent discount.

Another sample of background is a woolen cloth, made of red warp and white filling, and chemically prepared so as to readily dissolve when placed in a bath of a certain acid. This particular cloth is 160 centimeters (63 inches) wide, 54 by 54 construction, and the present Plauen price is 98 pfennigs a meter, say, 21.4 cents a yard, less 2 per cent discount.

The third sample shows one of the regular styles of bobbinet, made with 38 holes to the square inch. These nets are made very wide, so as to be the full width of the embroidery frame. The particular sample shown was 550 centimeters, or 6 yards wide, and the present Plauen price is 3.65 marks a meter, say, 80 cents a yard.

The fourth sample shows a square net. This net was 160 centimeters (63 inches) wide, has 17 meshes per inch each way, and the present Plauen price is 1.35 marks per meter, say, 29 cents per yard, less 2 per cent discount.



A 10-YARD SCHIFFLI MACHINE IN USE AT PLAUEN, THE LARGEST SINGLE MACHINE MADE.

The tulle used at Plauen formerly came almost entirely from Nottingham, but there are now tulle factories at Chemnitz, Plauen, Mülhausen, and other points, so that the larger portion of this foundation material is now obtained in Germany. Though tulle is not made in the United States, the superintendent of the large tulle factory at Chemnitz is an American. The bulk of the chemical cloth is also obtained in Germany. The general term for all laces made on chemically prepared cloth is guipure lace.

Laces can be made in greater variety of effects on the embroidery machine than is possible by any other method, except that of hand-made lace. The variety is much greater than is possible in the case of white embroideries, and is also greater than can be produced on the Levers lace machine, as the latter can not make the heavy and raised effects. Lacés are made on the schiffli machine at Plauen in imitation of every style of lace, from the heavy "Venice points" with relief to the lightest and finest old point laces. Some are so skillfully made that only an expert in this line can distinguish the difference, and whereas only the very wealthy could afford the genuine lace, the modern lace is made for the masses.

TECHNICAL TRAINING OF EXPERT DESIGNERS.

In making lace the salability of the finished article depends more on the artistic design than it does on the mechanical finish, and the designers of the finer class of laces are highly skilled men. The German Government fosters the creation of special schools located at every center that produces a specialty. In pursuance of this plan there is at Plauen a Royal Industrial School that is one of the best in Germany, and that has had a good deal to do, through the trained designers it has turned out, with extending and perfecting Plauen's special industry of etched lace making. Connected with the school is a museum which has one of the finest collections in Europe of old and modern laces. Such a museum is of great help to the student. In order to keep in touch with the industry there are branch museums at Eibenstock, Annaberg, Falkenstein, Auerbach, Glauchau, Meerane, and Frankenberg, the exhibits of which are exchanged with the central museum at Plauen.

The result of the study of the old designs by the young men being trained for a life work as designers has shown itself not only in the imitation of the old laces so exactly by machine as scarcely to be distinguished from hand work, but in the great number of new forms and combinations that are continually being introduced and by means of which the Plauen manufacturers are enabled to get the best prices and keep just a step ahead of their competitors.

MADE-UP GOODS—NUMBER AND ARRANGEMENT OF FACTORIES.

In connection with the manufacture of laces there has grown up a large business at Plauen in the manufacture of made-up goods. The large factories run this in connection with their regular manufacturing business, usually in a separate building, however, though it is really a special line in itself, and there are firms who do nothing else. For this work laces are manufactured in the special shapes desired and then sewed and fitted together to form collars, blouses, or whole dresses entirely of lace work. This sewing together is done

so skillfully on the finer work as to be almost indistinguishable, and the shaping and arrangement of the different pieces to form the finished article requires not only skilled hand work but also skilled brain work. The head women employed on this work have to be artists, and they get 300 marks and more per month.

The embroidery and lace manufacturers, of which there are some 450 in and around Plauen, are all private firms, with very few exceptions. The larger factories are mainly four stories, but many prefer to have only a part of the factory in several stories, usually the offices, storage, and finishing rooms, etc., and to have the bulk of the machines in a single-story sawtooth-roof building, so as to get perfect light and steady floor.

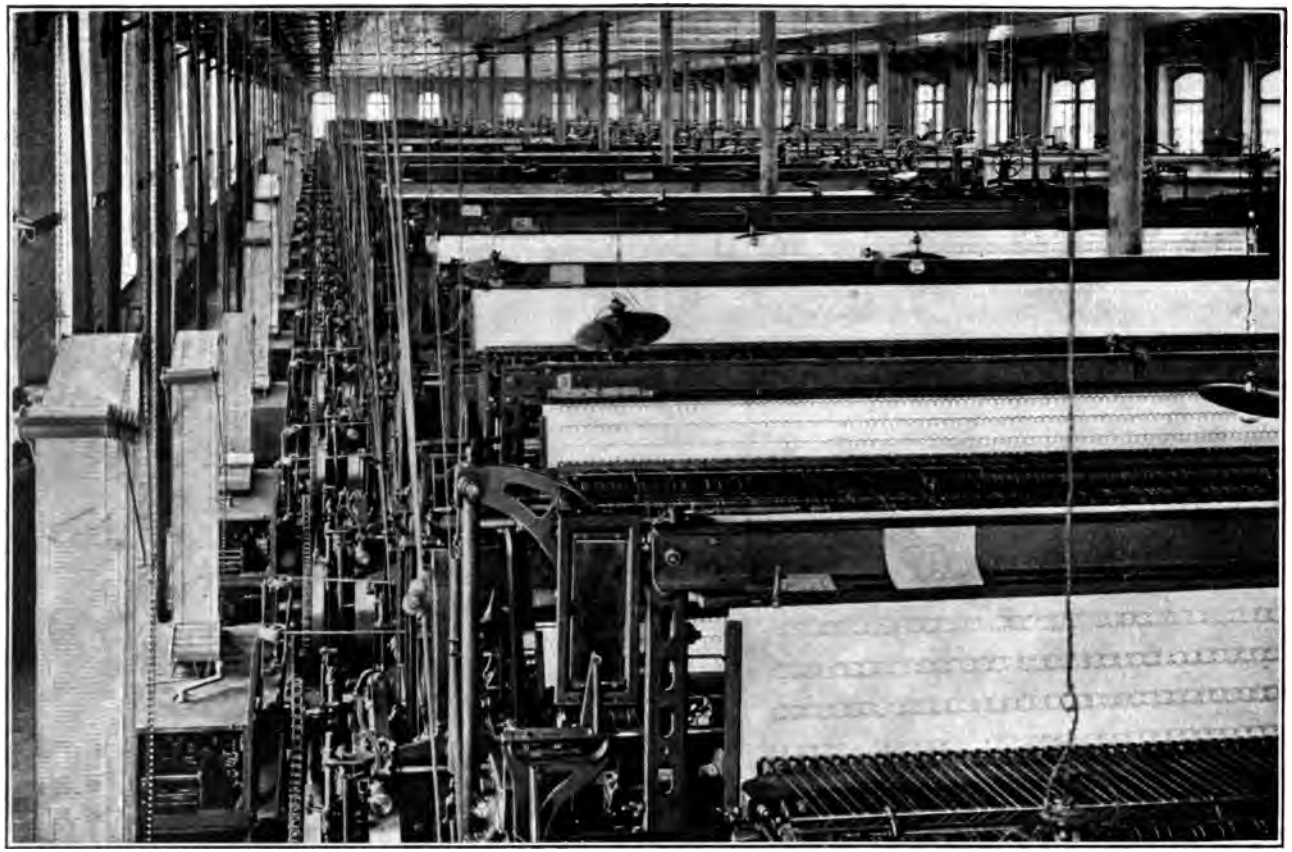
A typical factory is illustrated below, showing part of the building as four stories and part as one story. The long building in

A typical lace factory at Plauen.

the background is one of the model tenements that have been erected at Plauen for the special purpose of improving the housing conditions of the workers.

AUTOMATIC MACHINES AND THEIR COST.

Plauen uses a good many automatic machines, and their use is increasing. In this respect they are ahead of St. Gall. Their cost, however, is such that only the larger firms can afford them, but as a larger production with less wage cost is secured, the machines pay for themselves. On the pantograph machine there has to be employed a man as pantograph worker or "stitcher," one girl to watch the work, keep the bobbins filled, etc., and one girl to put the bobbins in the shuttles. On the automatic machine the stitcher is dispensed with.



AUTOMATIC LACE-MAKING MACHINES USED AT PLAUEN.

Very wide embroidery machines are now made by coupling together two 6¾-yard machines, so as to be worked by the same pantograph. There are a few of these in use at Plauen, but they are not liked by the operatives.

At one of the largest lace factories visited at Plauen were found 70 pantograph and 90 automatic machines. The majority of the machines were 5 yards long, using a double row of needles. The 4/4 rapport machine (needles spaced 1 French inch or 1.08 English inches apart) has 168 needles on each row, the 6/4 has 112, and the 12/4 has 56 needles on each row. The 5-yard pantograph machines cost this factory 4,500 marks and similar automatic machines 8,500 marks. The 9-yard automatic machines cost 15,000 marks. The regular charge at Plauen for the automatic attachment is 4,000 marks.

SPEED OF THE MACHINES AND PAY OF THE STITCHERS.

The speed of the embroidery machines was given by the superintendent as 120 stitches a minute, but on most of the work 90 would be averaged by the best stitchers, while the automatic machines could be counted on for 90 to 100. While this is the speed when working, there is necessarily loss of time for arranging the cloth, repairing some slight derangement, etc., and the actual production is much less than the theoretical.

At this factory the superintendent said that the best stitchers made from 220,000 to 260,000 stitches, according to the design, in a 63-hour week. At Plauen the "stitches" are given in terms that mean just double the terms at St. Gall. Thus at St. Gall the work done when a needle went through and back was called a stitch; at Plauen this would be figured as a double stitch. Thus the stitches made as above would be 110,000 to 130,000 a week at St. Gall, which is at the rate of about 32 double stitches per minute.

The stitcher was paid at the rate of 18 pfennigs (pfennig=about one-fourth of a cent) per 1,000 stitches, so on the supposition that he made 240,000 stitches a week (figuring on Plauen stitches), he would make 43.20 marks, or $10.28. The average stitcher gets probably 30 to 35 marks a week. On special work the stitch rate varies considerably and in some cases is 35 pfennigs per 1,000 stitches; the amount of work turned out on the fancy designs is less, so that the weekly wages are not augmented in proportion.

WAGES OF OTHER FACTORY EMPLOYEES.

The two girls on a machine, the one to watch the work and the other to keep the small shuttles filled, are paid, respectively, 18 and 14 marks per week. Their wages are the same usually, whether working on the pantograph machine operated by a "stitcher" or on a self-operated automatic machine.

The card punchers who operate the machines that punch the holes in the Jacquard cards for use on the automatic machines get high wages. The most expert can punch up to 6,000 holes a day. As this work requires a well-trained man, who is both quick and careful, the factories often employ the men by the year. At the factory in question there were six men so employed who were paid by piecework and guaranteed 200 marks a month. They really made 240 to 300 marks a month.

At the time of my visit the factory, owing to the curtailed orders, through depressed financial conditions, was only operating a few embroidery machines and had only one card puncher at work, but the others were drawing their 50 marks a week just the same.

This factory in normal times works an 11-hour day, with 8 hours on Saturday, or 63 hours a week. Factory employees are paid every Friday and home workers fortnightly.

EARNINGS OF THE HOME WORKERS.

General scissor and needle work, such as cutting off the threads between the embroidered portions, and repair work are mostly done at home. For cutting off threads the rate is 1 pfennig per thread running the width of the 5-yard piece. For sewing together collars, etc., and for repairing net, etc., the rate is 18 to 20 pfennigs per hour for home work and 20 to 22 pfennigs per hour for factory work, so that the weekly wages are about 12 marks.

The lace-machine work is more concentrated in factories than is the white embroidered work, though there is a very large number of lace machines worked singly in the homes or in lots of two to a dozen in rented rooms. In this case the manufacturer usually supplies the foundation material and the design and pays the man who owns the machine, the "Lohnesticker" as he is called, a fixed price per thousand stitches, and he has to provide out of this all the costs of manufacture, including yarn, wages, power, etc.

A great many of these lohnestickers work on rented machines, and in other cases they buy the machine on the installment plan. The latter, however, does not seem to be as generally the case as in Switzerland. The present rate supposed to be paid the lohnesticker for ordinary standard work is 70 pfennigs. Owing to the depressed conditions I found some taking the work as low as 56 pfennigs per 1,000 single stitches (two rows at 28 pfennigs rate to the row), but there is no profit whatever at the latter figure.

MEAGER PROFITS OF THE COTTAGE OPERATIVES.

Figuring that the lohnesticker gets off 180,000 single stitches on each machine, which is a good rate of work for first-class stitchers at home, and that he is working on regular designs at 70 pfennigs per 1,000 stitches, he will earn $30 a week from the factory for the work produced on each machine. His costs of getting off this work may be figured as follows at present rates of yarn and wages:

Cost of embroidery and shuttle yarn, say 2 marks per 1,000 stitches	$8.57
Stitcher's wages, at 18 pfennigs per 1,000 single stitches	7.72
Wages of machine hand, at 3 marks a day	4.26
Rent	.71
Electric power	.47
Heating, light, and supplies	1.43
Interest and depreciation	1.90
Repair and inspection of goods	1.19
Machine repairs	.47
Sick insurance, porterage, and incidentals	.83
Allowances 1½ per cent	.45
Total	28.00

This leaves the lohnesticker only $2 profit on his machine for the week's work, and if the rate is 28 pfennigs per 1,000 stitches (56 *pfennigs per 1,000* for the piece) he is actually losing money, unless

he has only one machine which he operates himself at home, in which case by cutting all expenses down to the minimum he can make a very small wage. In times like this the home workers who depend on the factory to supply them with work naturally feel the depression first. The cost of operation varies according to the conditions under which the home work is done, but the foregoing figures are sufficiently accurate to give an idea of the general conditions and of the proportionate costs of ordinary work.

RATES CHARGED FOR ELECTRIC LIGHT AND POWER.

All of the factories use electric power, as do also a good many of the lohnestickers. One or two factories have their own plant, but the great majority get their power from the electric plant owned by the city, which has a monopoly for supplying electric power within the corporate limits. For light the rate is 70 pfennigs per kilowatt hour, less 12½ per cent, but for power a special rate is made of 20 pfennigs per kilowatt hour, less 15 per cent, with the condition that contracts must be made by the year on a basis of at least 300 kilowatt hours. A reduction of 15 per cent is made for every 100 kilowatt hours up to 20,000. If there is an annual consumption of more than 20,000 kilowatt hours, then the rate per kilowatt hour is reduced to 16 pfennigs flat. For current for heating and for electro-chemical apparatus an additional 10 per cent is added to the regular power rates. The ordinary 6/4 rapport pantograph machine 5 yards long takes about one-fourth horsepower and the similar automatic machine nearly one-half horsepower.

[Illustrations of factories and machines, and one sample of embroidered work in colors, forwarded by Mr. Clark, are on file in the Bureau of Manufactures.]

RIBBON WEAVING.

MODERN MANUFACTURING METHODS—COSTS AND PROFITS—LARGE SHIPMENT OF PRODUCTS TO THE UNITED STATES.

A ribbon loom uses a series of shuttles for weaving a number of narrow bands, and for a great variety of purposes. It is made in various widths and divisions, and either with or without attachments, such as leno and Jacquard apparatus, etc. The German ribbon manufacturers touch all sides of the textile trade. They make plain and fancy weaving, imitate lace work, imitate embroidery, imitate braiding work, and, in fact, make everything, either plain or fancy, that can be woven in narrow widths.

The materials employed on the ribbon loom are of all kinds—cotton, wool, silk, linen, jute, rubber, gold and silver threads, etc. The products include plain ribbons or tapes in plain, twill, satin, or rep weaves; name bands for shoe and coat straps, cap and hat bands, hat forms of iron yarn, laundry ribbons, velvet edgings, ribbons interwoven with rubber threads for boot elastics, tubular elastics, bandage holders, etc.; carriage braids, cords, girths, straps, belts, hollow bands and neckties, Venetian-blind bands, ribbon-loom lace, handle and other stiff bands, corset and apron trimmings, dress trimmings, millinery ribbons and trimmings, fancy bands with either warp or filling figuring, etc.

CENTER OF RIBBON-LOOM INDUSTRY.

Barmen is the center of this specialty in Germany, and in 1907 this town alone shipped to the United States $990,900 worth of hat bands and ribbons, besides galloons, trimmings, edgings, name bands, elastics, etc., so that of the product of th ribbon looms at Barmen there was shipped to the United States some $[illegible],500,000 worth in this one year. The majority of these goods should have been made in the United States.

The great bulk of the German "Bandweberein," or ribbon-loom manufacture, is carried on at Barmen, but there is also considerable manufacture in the neighboring towns of Elberfeld and Crefeld, and a smaller center around Pulsnitz and Gross-Rohrsdorf, in Saxony.

Barmen is the center both of the German ribbon-loom work and of German braiding work. These specialties make Barmen an important textile center, and to show the range of the textile industries at this place a list of the 34 textile industries of this town, with its three

small neighbors, follows, the list being furnished by the Barmen Chamber of Commerce as showing the situation January 1, 1907:

Industries.	Factories.	Operatives.	Industries.	Factories.	Operatives.
Braiding machines	98	5,077	Bleaching and finishing yarn, lace, ribbons, etc	8	174
Ribbon loom	864	6,974	Finishing yarn, lace, ribbons, etc	13	87
Ribbon looms and braiding machines	13	2,511	Iron yarn and sewing thread	5	512
Ribbon looms and braiding machines, dyeing and finishing	1	194	Iron yarn and sewing thread and braiding work	4	1,228
Ribbon weaving and iron-yarn manufacture	1	490	Iron yarn and sewing thread with bleaching and finishing	3	273
Fabrication of elastic goods	20	1,176	Iron yarn and sewing thread with cop dyeing	1	62
Ribbons, lace, and cords (hand work)	43	577	Passementerie fabrication	24	886
Mechanical weaving of mixed goods	9	1,010	Knit goods	3	80
Mechanical weaving and iron-yarn manufacture	1	133	Coverings for smokers' pipes	3	89
Mechanical weaving of upholstery goods	1	193	Mechanical warp preparation	1	29
Cloth manufacture	1	73	Button manufacture (metal and cloth)	12	927
Carpet manufacture	1	433	Turkey-red dyeing	4	230
Spinning, weaving, and printing	1	737	Home spooling	36	280
Piece dyeing and finishing	3	600	Combed knitting	3	11
German blue cotton prints	5	414	Chemical preparation and fine dyeing	7	96
Calendering and finishing mixed goods	3	56	Renters of room and power	17	19
Dyeing and finishing yarn, lace, ribbons, etc	44	995	Prussian High School for Textile Industry	1	3
			Total	1,254	26,629

The foregoing is divided up as follows: Barmen, 877 factories and 21,425 operatives; Schwelm, 364 factories and 3,921 operatives; Hagen, 4 factories and 783 operatives; Iserlohn, 9 factories and 500 operatives.

FACTORIES, OPERATIVES, AND WAGES.

Barmen's many textile industries are more or less specialized, but the main machines are the ribbon looms and the braiding machines. The contrasting figures for 1905 and 1906 in regard to factories, operatives, and total wages are as follows:

Description.	1905.	1906.
Factories ... number	1,263	1,308
Operatives ... do	24,783	25,991
Total wages ... marks	23,786,220	25,862,601
Average wages per operative ... do	960	995

Assuming three hundred working days to the year this is 3⅓ marks, or, say, 80 cents a day. It will be noticed that wages are gradually advancing, and also that more workmen are being employed each year, and this is especially true of the braiding and ribbon factories.

The manufacture of ribbons and similar narrow goods at Barmen is a growing industry and the sales thereof to the United States are yearly increasing. The majority of these goods should have been manufactured in the United States, but the German ribbon manufacturers, notwithstanding the tariff, seem to be able to compete with American ribbon-loom manufacturers in their home market, partly due to the fact that they cater to the market, continually getting out new designs and manufacturing special orders of any size desired. Their costs of manufacture are also less, but wages are increasing yearly. The fact that the ribbon manufacturers will take orders of

any size is one factor that helps them both at home and abroad. On name bands, for instance, with the name woven in silk on cotton tape one-half inch wide, the Barmen manufacturers charge 2 marks (7.6 cents) for one tape containing 12 dozen repetitions of the name, and will punch a Jacquard pattern and weave only one tape if that is all that is ordered.

TYPES OF RIBBON LOOMS.

There are two main types of ribbon looms, the first (represented by fig. 15) having banks or chests of shuttles that move in a straight line to the right and left, like the shuttles of an ordinary loom, but with much shorter travel, while the second type (represented by fig. 16) has shuttles that move in semicircles, the tracks of which cross each other. In a variation of the first type of an ordinary loom as

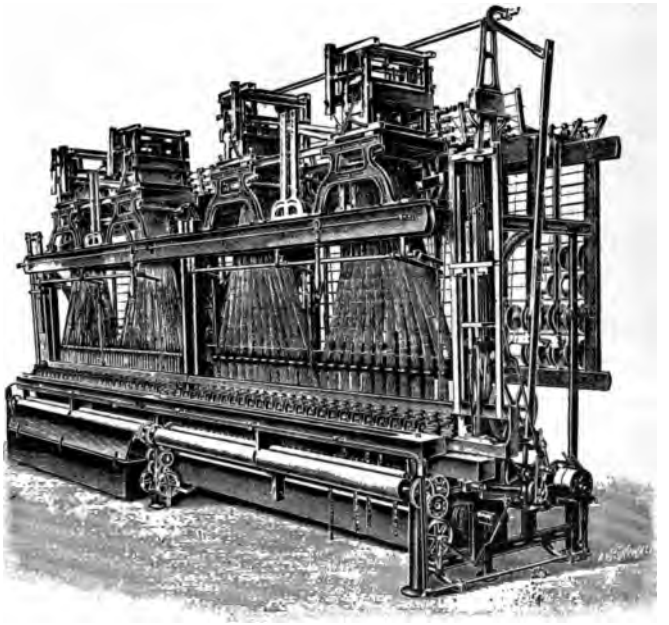


FIG. 15.—First type of ribbon loom.

made in Barmen the shuttles are arranged in banks one above the other and the small warps run through narrow reeds placed in openings in the lay between each bank of shuttles. Each bank consists of six shuttles, but may be of any number from two to eight. Ordinarily six shuttles to the bank is as many as is employed, and three or four is the more common number. The lay in an ordinary loom swings back and forth only, but in most ribbon looms it is also arranged to slide up and down, so as to throw in a particular shuttle, say the bottom, the middle, or the top one, through the center of the warp shed.

The shuttles are moved by racks. The shuttles extend out horizontally from the lay, and a couple of small gears fit into the rack in the shuttle. These small gears in turn are moved by means of a long rack placed either at the top or bottom of the lay so as to be clear of

the small warps. Each rack runs the length of the lay. Where there are only two shuttles to the bank there is one rack at the top and one at the bottom. Where there are four shuttles to the bank the lay is thicker, and there are two racks at the top and two at the bottom placed one behind the other, the rear one being deeper, so as to enable it to gear with the second shuttle, and if there are six shuttles to a bank three racks, one behind the other at top and bottom, etc., are required. The curved-shuttle looms are mainly used, without Jacquards, for making cigar bundle bands and similar work, as they are not suited for fancy work, as is the straight loom.

COST AND OPERATION OF LOOMS.

On ribbon looms making plain goods the shafts are moved by cams, but the larger portion of the ribbon looms have a Jacquard attach-

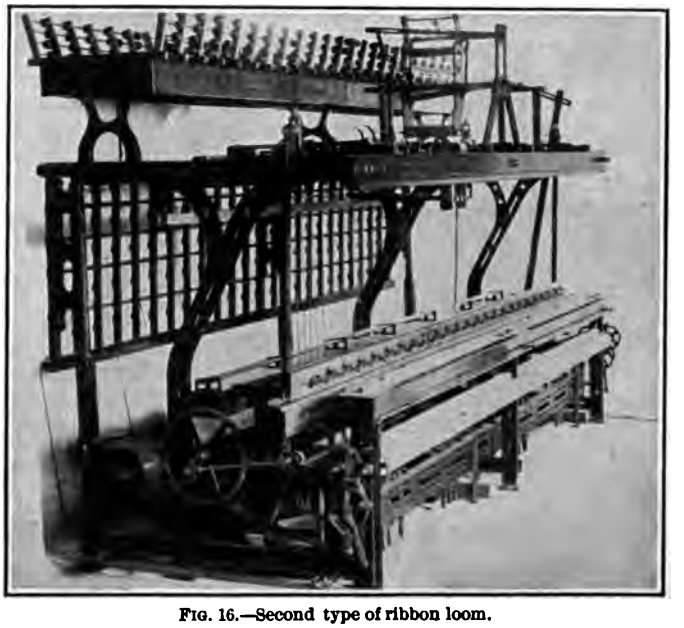


FIG. 16.—Second type of ribbon loom.

ment. The Jacquard arrangement is similar to that of ordinary Jacquard looms. For wide looms, as shown in fig. 15, there are employed four and sometimes six Jacquards. The ordinary ribbon loom is four meters (4.37 yards) wide, makes 20 ribbons at a time, in three colors, and is fitted with Jacquard attachment. The present price of such a loom is given me by one of the largest German manufacturers in this line as 1,500 marks ($357) at Crefeld. The German ribbon looms are much cheaper than the American. They are also made differently, for whereas the American ribbon loom is made of iron wherever possible, not only the gears and racks, but the lay and frame being of iron, the German loom is made of wood, and iron is only used where unavoidable. The lay, racks, frame, etc., of the German ribbon loom are all wood, which makes a lighter and cheaper loom. The German ribbon-loom manufacturers also claim that their system of rawhide gears, interposed between the wooden racks in the shuttles

and the long wooden racks, makes not only a much more silent but a more lasting mechanism than the American loom with iron gears working in an iron rack.

Ribbon looms are made in a great variety of forms, according to the purpose for which intended, from very light looms for plain ribbons up to very heavy looms for weaving girths and belts. The number of divisions—that is, of separate warps—and the width may be as desired. The widest looms are about 8 meters (8.75 yards); possibly a few are over this. In each wide loom there are two independently operated lays, so that each is two looms with one breastbeam. Not only are several Jacquards employed for the wide looms, but the cards may be so arranged that each ribbon is of a different design from that of its neighbor. Each of the separate warps is wound on its own spool, with separate spools for the selvages, but, according to the pattern, the warp may be wound on two, three, or more spools. This is especially necessary where portions of the warp are under a different tension from that of the others. The looms stand some 8 feet high, and the ends from the warp spools run over carrier spools and down under a rod to the reed. Each warp thread or set of threads has its own weight attachment to take up the slack.

Leno attachments are common and have a similar needle arrangement of two heddle frames, one behind the other, whereby various designs can be produced in imitation of embroidery and similar work. Sometimes on a six-shuttle bank loom there will be made two ribbons, one above the other, each using three of the shuttles.

SPOOLING AND OTHER PROCESSES.

In considering the work of a ribbon-loom factory the first operation is spooling. The yarn is usually bought in hanks, and this, if warp yarn, is wound from the skein onto spools of the required size, and may be fitted up with any number of spindles from 4 to 20. Sometimes the yarn is bought from neighboring factories on the spool, and then a number of these spools are wound together directly onto the warp spools to be placed on the loom. Very frequently the factory has no spoolers, in which case it buys the yarn in the numbers and amounts desired of each and has this spooled outside in an establishment that does nothing else. If it is desired to have the yarn dyed, bleached, or otherwise prepared, the factory will also have this done at a special establishment and then spooled and warped at another establishment before they start on their share of the manufacture. The largest factories, even, usually have some of the processes, especially the dyeing or the bleaching, carried on at some place that makes a specialty of this one process. The warp is wound on large spools, while the filling is wound onto small bobbins for the shuttle. The thread from a bobbin goes through spring hooks on either side of the inside shuttle circle and then horizontally out through the hole at the bottom. The wires at the top press on the bobbin to keep it from unwinding too fast.

After weaving, the ribbons are inspected, calendered, cut up in desired lengths, and then put up for the market, being first wound on pasteboard, then packed in little boxes, wrapped in paper, and these packed in larger boxes, ticketed, and shipped.

The ribbon looms at Barmen are partly run by steam and partly by electric power. Some are operated by direct-connected motors.

The speed of the loom varies widely according to the width of loom, the number of ribbons being made, the number of shuttles, the fineness of the yarn, the pattern, etc., and may be from 80 to 200 picks a minute. For ordinary ribbons using Jacquard attachment the speed many be given as 120 picks per minute.

There is a machine for gluing together warp threads for making what is called "baft ribbons." These ribbons are used in place of twine for tying purposes, and as artificial bast or straw for making hats, etc.

YARN TWISTING AND NUMBERING—WEAVERS' WAGES.

The cotton yarn used is numbered the same as the English, though the French half metric system is occasionally used. It is interesting to note that the terms "right-hand twist" and "left-hand twist" mean in Germany exactly opposite to what they do in the United States. In the United States "right-hand" yarn is yarn of which the twist slopes up to the right similar to the threads of an ordinary right-hand screw. Germans call this "left-hand" yarn for the reason that if held in the hand it has to be twisted to the left to twist it together, whereas twisting to the right unwinds it.

Considerable lustered or iron yarn is used in weaving hat forms, etc., and the export of these forms to the United States is a big indus-

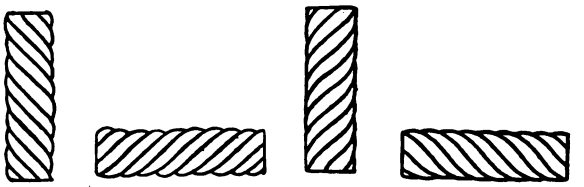


FIG. 17.—*a*, *a*, German right-hand twist; *b*, *b*, American right-hand twist.

try. There are separate factories at Barmen, Blankenstein, Breyell, Crefeld, and Langerfeld for making this iron yarn. The yarn is heavily sized and glazed and thereby becomes heavier and harder, but the length remains the same. This iron yarn is reckoned differently from the English numbering, which is usually employed for cotton yarns in Germany, as a hank is taken as 275 meters (300 yards).

For numbering the metal threads of gold, silver, copper, aluminum, etc., which are usually wrapped around a central thread of flax or cotton, there does not seem to be any fixed rule. For 50/2 gold thread there are 10,000 meters to the kilo and for 70/3 gold thread there are 10,500 meters to the kilo. The india rubber employed for interweaving with cotton and silk to make garters and other elastics comes in hanks of 66 yards to the bundle. The number of these elastic threads is based on the thickness of the cross section—that is, the number that can be laid side by side in an English inch.

Wages in Barmen and the surrounding section are higher than in most other textile centers of Germany. Ordinary weavers will average 60 to 80 cents a day and weavers on special work will get as high as $1.43 a day or more.

COST OF MANUFACTURING RIBBONS.

The following condensed translation is taken from a handbook recently issued by Prof. Otto Both, of the Prussian Textile High School, at Barmen, and is reproduced here because it serves very well to illustrate the method of figuring used by the German manufacturers in getting at the cost of manufacture of a special ribbon and also shows how they have to shift their calculations between yards, meters (meter=39.37 inches), pounds, and kilos (kilo=2.2 pounds):

We will figure on the cost of making a thousand meters of a fancy ribbon made up of colored cotton, dyed cotton, and dyed silk thread, using white cotton filling. There will be required three warps, the first with 16 ends of No. 100/2s (English numbering) colored cotton yarn, the second with 84 ends No. 60/2s (English numbering) white cotton yarn, and the third with 40 ends No. 46/48 (International numbering) China organzin colored silk thread. For filling we will use No. 50s single (English numbering). The pattern is such that to make 1,000 meters finished ribbon there will be required 1,100 meters of the 16-thread warp, 1,120 meters of the 84-thread warp, and 1,050 meters of the 40-thread silk warp. To these lengths we will add 5 per cent to cover the waste in spooling, warping, etc.

We will first find the weight of the materials to be used: First warp, 16×1,100=17,600+5 per cent=18,480 meters. 100/2 ply is the same as 50s single in weight, and a hank is 768 meters (837 yards), so we have for the weight of this warp 0.48 pound, or 0.218 kilo.

Second warp, 84×1,120=94,080+5 per cent=98,784 meters. This divided by 30×768 gives the weight of the second warp as 4.29 pounds, or 1.946 kilos.

Third warp, 40×1,050=42,000+5 per cent=44,100 meters 46/48 silk yarn. As this is International numbering, we divide 44,100 by 10,000 and have the weight as 4.41×47 grams=207 grams.

Filling.—The length of filling required can only be ascertained by actual trial. In this case for 1,000 meters of finished ribbon there is required 112,000 meters of filling, and to this we will add 4 per cent for waste allowance, so that the actual length of filling needed will be 116,480 meters. The number is 50s English single, so the weight will be 116,480 divided by 50×768, or 3.03 pounds, which is 1.374 kilos.

Part of the yarn has to be dyed and another part bleached, and then the filling wound on bobbins and the warp spooled and warped. To obtain the costs per pound of the materials ready for the looms, we will figure as follows:

Description.	Marks.	Description.	Marks.
One pound 100/2s in the gray	3.20	One kilo No. 46 China organzin silk	38.00
Dyeing per pound (90 pfennigs per kilo)	.405	Dyeing per kilo	3.50
Spooling per pound (50 pfennigs per 100 hanks)	.25	Spooling per kilo	2.00
Total	3.86	Total	43.50
One pound 60/2s in the gray	1.80	One pound filling No. 50s water in the gray	2.80
Bleaching per pound (1 mark per 10-pound bundle	.10	Bleaching per pound	.10
Spooling per pound (60 pfennigs per 100 hanks)	.18	Spooling per pound (60 pfennigs per 100 hanks)	.30
Total	2.08	Total	3.20

When the warping is made up, as in this case, of different yarns the warping is usually based on the 10,000 meters, the price ranging from 5 to 10 pfennigs. In the present case we are charged 7½ pfennigs per 10,000 ends of the cotton ply yarns, and 6 pfennigs per 10,000 ends of the silk yarn. The first warp has 16×1,100, or 17,600 meters length, and the second 84×1,120, or 94,080 meters, making a total length of cotton ply yarn of 111,680 meters, which, at 7½ pfennigs per 10,000 meters, is 84 pfennigs (20 cents). The silk yarn has a length of 40×1,050, or 42,000 meters, which, at 6 pfennigs per 10,000 meter, is 25 pfennigs (5.95 cents), making the total cost of warping the three warps 1.09 marks (26 cents).

WEAVING AND PLACING ON MARKET.

The next process is weaving. We will calculate on 400 picks per 10 centimeters (a little over 100 picks to the inch), and that the loom runs 120 picks to the minute and makes 64 ribbons at the same time. In ten working hours the loom will make 120×60×10, or 72,000 picks, and allowing 25 per cent for loss of time by stoppage the daily production will be 54,000 picks; dividing this by 4,000 picks to the meter gives 13.5 meters per division per day or, say, 80 meters a week and 64×80, or 5,120 meters, of ribbon to the loom per week. If we give the work out to a "meisterlohn" (a man who owns a few looms and does weaving by contract when the material is supplied), he will figure on a charge of 60 marks ($14.28) per loom per week, and guarantee the 75 per cent production above. The cost of weaving the 1,000 meters we desire will be about 12 marks ($2.856).

Next, we have the cost of knotting the fringes, if there are any, the calendering and cutting up, inspecting, etc., which we can figure on as 2 marks (47.6 cents) per 1,000 meters.

Next comes the cost of putting up for market, the reeling on cardboard, packing in paper, ticketing, etc.; 12 meters are put into each small box and ticketed, and one dozen of these wrapped in paper, ticketed, and put in larger pasteboard boxes. Figuring on 10 of these boxes, or 1,440 meters, we find the costs of putting up, etc. to be about as follows:

Description.	Marks.	Description.	Marks.
100 dozen reels at 6 pfennigs a dozen (reeling wages)	6.00	Paper, 4 dozen to one sheet, costing 5 pfennigs	1.25
1,200 small tickets, 100 packets, at 50 pfennigs	6.00	Binding thread, half kilo per dozen	.34
100 dozen, binding and folding up (workers' wages)	1.50	100 tickets	.25
		Total	15.34

This was for 1,400 meters; so for 1,000 meters the cost would be 10.65 marks ($2.535). In this case, as we are figuring on the work being given out for weaving, we do not have to consider cost of power, etc., but for the general company expenses we will allow 7½ per cent. The manufacturing costs of this 1,000 meters (1,090 yards) of ribbon will be found to be as follows:

Description.	Marks.	Description.	Marks.
Cost first warp, 0.48 pound, at 3.86 marks per pound	1.85	Weaving cost	12.00
Cost second warp, 4.29 pounds, at 2.08 marks per pound	8.92	Finishing costs	2.00
Cost third warp, 0.207 kilo, at 43.50 marks a kilo	9.00	Costs of putting up for market	10.65
Warping	1.09		55.21
Cost filling, 3.03 pounds, at 3.20 marks per pound	9.70	Company costs, 7½ per cent	4.14
		Total	59.35

This shows a total of $14.12, or 1.41 cents a meter. In selling there will be given a 4 per cent cash discount, and the selling agent will charge 5 per cent commission, so to the above 59.35 marks there will have to be added 9 per cent, making the gross cost price 64.69 marks ($15.40).

To the above should be added the manufacturers' profit, which will vary according to the demand and the competition, and if it is sold to a foreign country there will need to be considered the transportation costs and the duty. The above, however, gives an idea of the method of figuring employed and the comparative costs.

[Many pictures illustrating the machinery described in the foregoing report, as well as German ribbons, may be seen at the Bureau of Manufactures.]

KNIT GOODS MANUFACTURE.

CONCENTRATION, GROWTH, AND PRESENT IMPORTANCE OF THE INDUSTRY—KNITTING MACHINES AND PRODUCTS.

While the manufacture of knit goods is a larger industry in the United States than in Germany, in 1905 the United States bought from Germany knit goods to the value of $5,945,807, and this was increased to $7,267,617 in 1906, and to $8,384,830 in 1907. About 90 per cent of the knit goods bought abroad by the United States in 1907 came from Germany.

The knit-goods industry is one of the most important branches of German cotton manufacturing, and the export trade in this line is very large. The United States is the best customer, especially for hosiery, and takes large quantities, though owing to the great increase of knitting in the United States and to the growing demand from other sections of the world the proportion taken by the United States is less than formerly.

The bulk of the German knit goods is made in and around Chemnitz, but Limbach has also become an important center for knitted underwear, Thallmein for gloves, Apolda in Thuringia for shawls, caps, and general knitted goods, while other smaller places are centers for certain special lines.

EARLY CONCENTRATION OF THE INDUSTRY AT CHEMNITZ.

The golden years of the Chemnitz knit-goods industry was the period before the expiration of the patent on the knitting goods machine invented by Cotton. Favored at that time by the quick growth in the use of knit goods abroad, especially in North America, the rapid perfecting of means of communication, and the active development of great export houses in Chemnitz, and aided by the passing of certain competitive districts abroad, especially those in England, Chemnitz and the neighboring towns in the valleys of the Uskaberger Mountains became active in this industry and developed it at a rapid pace.

Even before this, the fact that the manipulation of the old machines required a slow apprenticeship from youth, together with the natural disinclination of Saxons to wander, had a tendency to concentrate and retain the industry in one place. The machine invented by Cotton tended to the erection of large factories and still more centralization, because its costliness, its heavy requirements for power, and its difficult manipulation rendered it unsuited for small users. Its introduction marked the start of the great central factories in Chemnitz. The protection given by patent rights, and the continually increasing market abroad, enabled Chemnitz to perfect the organization of the working force in these big factories and tended still more to give them the undisputed leadership in this line.

GROWTH OF COMPETITION AT HOME AND ABROAD.

Since the expiration of the Cotton patent, in 1883, new competitors have arisen, especially in the United States, and Chemnitz no longer enjoys the complete supremacy formerly accorded it. The manufacturers of knit goods in other countries quickly availed themselves of the coveted rights, and were aided by the German makers of knitting machines, who, anxious for a market for their increasing production, were ready to sell to any country and to give any terms required. A reduction in wages at Chemnitz at this time, brought about by the breaking down of the knitting monopoly there, also tended to scatter the workers abroad and to give their competitors the skilled operatives of whom they were in need. There has, therefore, been increasing competition both at home and abroad, and profits have become much reduced.

With all these difficulties, however, and in spite of the fact that wages are rising, the industry is a prosperous and a growing one, and with the aid of their cheaply paid but highly skilled workmen operating the most improved machines they are able to compete with foreign factories in their home markets, notwithstanding high tariff rates.

FOREIGN MARKETS, TRADE METHODS, AND TERMS OF SALE.

At Chemnitz hosiery is the great specialty, and after that knitted gloves and underwear. According to the president of the Wirkwaren Fabrikante Vereinigung von Chemnitz und Umgegend, about 50 per cent of the Chemnitz output of hosiery finds a market in the United States, though this is a smaller proportion of the total than in former times. At present this dependence on the American market has resulted in a large number of the factories running short time or closing down, due to the financial conditions in that country.

In knitted gloves England is Germany's best customer, with the United States second. The underwear made at Chemnitz is mainly for home use, but considerable amounts are taken by neighboring nations of the Continent, and smaller amounts sent to England and the United States. The Germans cater to the particular requirements of each country, each class of goods being especially made for the market in which it is to be sold, and the fact that they do so, and recognize that goods made for Germany could not be sold in the United States, and that goods made for England could not be sold in Italy, has much to do with their success as exporters.

In selling hosiery and other knit goods the usual terms are for cash, less 4 or 5 per cent discount. The manufacturers sell direct to large commission houses at Chemnitz and to buyers established there or to traveling buyers. There are 88 American houses represented at Chemnitz. The larger of these pay cash, and others give bills of exchange on London. A few buy on open account and a few remit money on receipt of goods.

STYLES OF HOSIERY KNITTING MACHINES IN USE.

The makers of knitting machines at times make larger profits than do the knit-goods manufacturers, but their business is subject also to fluctuations. A number of Chemnitz knitting machines are sold to manufacturers in the United States. The prices of such machines vary, but the present price on a 16-division Cotton machine is 7,000

marks ($1,666). Such a machine will make 12 dozens of ladies' hose or 26 dozens of socks in ten and one-half hours, running 50 to 60 courses per minute for plain fabrics. For striped fabrics the speed will be reduced to 40 to 46 courses per minute.

There are two principal systems employed in making hosiery, the "full-fashioned" and the "seamless." In the full-fashioned the body of the stocking is knitted out flat on a machine which makes a dozen or more at a time, and then these are sewed together. The seamless stockings are made on a circular knitting frame. The first system is most used in Germany and the second in the United States. The curves can be better obtained by the first system, and the cost of operation is usually cheaper, but a seam is left where the parts are joined together.

At first hosiery was made at Chemnitz on hand machines, and these are still used in the more remote sections of Saxony. Then there were used small Paget frames, and now there are used the Cotton frames, making 12 to 24 stockings at a time. On most grades the managers have found by experience that a 20-stocking machine is the widest that a workman can manage efficiently, and on specialties this number has to be much reduced.

Formerly the demand was for heavy goods, but to-day light hosiery and underwear sell the best, while mercerized and fancy effects are very popular. In knitted gloves the demand is for longer styles.

YARN SUPPLY AND SYSTEMS OF NUMBERING.

Hosiery is made mostly from yarns ranging from 10s to 32s, but some is used up to 100s, and even in smaller amounts up to 200s. The majority is single, but some is doubled. For knit goods in general 18s to 60s single cops are used. A large amount of Egyptian yarn is employed in this trade. The yarns required are mainly furnished by Saxony, but there is a large amount bought from England and smaller amounts from Bavaria, Bohemia, and other sections. Vigogne and imitation vigogne yarn, made of cotton and wool or wool waste or made of cotton and cotton waste, is used in cheap underwear and to some extent in stockings.

In buying and figuring on cotton yarns at Chemnitz the numbering is almost entirely by the English system of the number of 840-yard (768 meters) hanks contained in a pound. To a much smaller extent there is used the metric or decimal system of numbering, according to the number of hanks of 1,000 meters contained in 1,000 grams. In worsted yarn there are used two systems of numbering, the German, which makes the worsted hank the same as the cotton hank of 768 meters, or 840 yards, and the English system, which gives a worsted hank a length of only 560 yards, so that in buying worsted yarns the Saxon manufacturer always specifies whether long or short reel. For woolen yarns the same numbering as for short hanks in worsteds is generally used. A German authority says that as woolen yarns require about 15 per cent of oil in spinning, and worsteds as spun in England a very small quantity, when the former is wound it is from 12 to 15 per cent finer than the latter, the sizes being always calculated from the weight of the yarn in oil.

MEANING OF "GAGE" AS APPLIED TO MACHINES.

Knitting machines are usually designated according to the "gage," *but this* term has a different meaning in England, in France, and

in Germany. The knitting needles—that is, the frame or hooked needles—are fastened in "leads" made of a mixture of lead and tin, usually two needles to a lead.

In England the gage or fineness of a frame signifies the number of leads, each containing two needles, which lie in a space of 3 inches. A No. 24 gage machine therefore has 2 times 24 or 48 needles to 3 inches, which is 16 needles to the English inch.

In France they first used the same system based on 3 of the old Paris inches, but they now use two gages, "gros" and "fin," based on 3 French inches, a French inch being one thirty-sixth of a meter (1 meter=39.37 inches). This French inch has come into use because of the inconvenience of the decimal numbering of the meter for divisions into twelfths, etc. The "jauge gros" is used for gage numbers up to 27s, and the "jauge fin" for gage numbers from 20 up, the first meaning the number of two-needle leads in a distance of 3 French inches, and the latter the number of three-needle leads in a distance of 3 French inches.

In Germany they sometimes use the French system of numbering, which is due to the fact that knitting was first introduced from France, and some factories use the English system, but owing to the inconvenience of both the majority of the Saxon machines are now based on a gage which is the number of needles to a Saxon inch, which is a more direct and simple method than either of the others. Thus 24-gage Saxon means 24 needles to the Saxon inch.

The French inch is equal to 1.0936 English inches, and the Saxon inch is equal to 0.9291 of an English inch, so No. 24 gage would mean, according to the various systems, the following number of needles to an English inch: English, 16; French gros, 14.63; French fin, 21.95; Saxon, 25.83.

In Saxony the gages run from 24 to 51, the machines in common use having gages (Saxon) of 30, 33, 36, or 39. In England the gages (English) in common use are 24 and 27.

FACTORY OWNERSHIP, EMPLOYEES, HOURS, AND WAGES.

The Saxon knitting factories are all private concerns, with the exception of one joint stock company, which is English owned. The managers say that this is due to the fact that knitting is a specialized industry, and that in these days of close competition it is necessary to have a man at the head who is vitally interested in the success of the business and untrammeled by any outside authority. It may also be a factor that stock companies have to publish in newspapers accounts of their standing while private companies do not. The capital in a knit-goods business is not as important as is the management.

Some factories at Chemnitz pay employees weekly and others fortnightly; usually one week's wages are held back. The hours of work are either 61, 60, or 59, more commonly the last, and the factory runs from 7 to 12 o'clock, with fifteen minutes intermission, and from 1 to 6.30 o'clock, with fifteen minutes intermission. They do not usually close on Saturday afternoons, but stop work one hour earlier.

Wages in the knit-goods business in Saxony, while low as compared with other sections, are increasing, and owing to the great demand for female labor the wages of the women are rising more in proportion than those of the men. In the knit-glove industry there has been an advance in most places of from 60 to 100 per cent in the last two years alone. At the present time wages are again lowered, but

this is temporary, due to the financial depression, and as the cost of foodstuffs is continually advancing labor costs will become more and more a factor to be considered by the Saxon knitter, in spite of the fact that the dense population of Saxony—the densest in Europe—has heretofore given them an advantage over any of their competitors. Their labor is at present, and will probably continue to be, even with advances in the future, cheaper than that of their rivals in Troyes, France, and Nottingham, England.

DIVERSIFIED CONDITIONS AFFECT WAGE SCHEDULES.

Labor unions in Saxony have endeavored to fix uniform schedules of wages for the different classes of work in the knit-goods industry, and in this they have had the good will of some of the manufacturers, but owing to the different makes, sizes, and speeds of the machines, varying the production of each worker, and also to the many variations in the methods of work and to the great number of special varieties of goods made, it has been found thus far too difficult to generalize. There is, therefore, not the slightest uniformity in regard to the wages paid, each manufacturer getting his help as cheaply as he can, and every time he introduces a slight variation or starts on some new specialty there is a period of seesawing until the remuneration to be paid is steadied temporarily.

Between two factories working side by side on the same general class of goods there is frequently to be found a wide variation in wages paid, according to whether the machines used are old or new, the size and speed of the machines, the popularity of the manager, and the privileges he accords workers, etc. Various managers of whom I inquired as to average prices paid said that they knew their own prices and that of a few of their competitors, but that they had but a vague idea as to what could be considered average wages for the various classes of goods.

To show the variations in wages and the minuteness with which such wages have to be adjusted, even in one factory running on a limited variety, I have obtained the following prices now being paid in a hosiery factory where the operations were as follows: Spooling yarn, knitting leg, running on foot, knitting foot, heeling and toeing, seaming, and mending. The dyeing and finishing are done outside. The prices are all given in pfennigs, owing to the difficulty of giving the equivalents in cents without too many decimals. To change pfennigs into cents, multiply by 0.238.

SPOOLING.

[Wages in pfennigs, per pound English.]

Yarn numbers (English)	8–15	16–20	21–30	31–40	41–50	51–60	61–70	71–80	81–90	98	112
Cotton cops:											
Spooler	2	2¼	2¼	2½	2¾	3½	3½	3¾	4¼	....	....
Rewinder	1½	1¾	2	2¼	2½	2¾	3	3¼	3½	....	....
On patent winder	2½	3	....	....	....	....	....	....	....	....	....
Wool cops:											
Spooler	1¾	2	2	2¼	2½	3	3½	4	5½	8	12
Rewinder	1¼	1½	1¾	2	2¼	2½	2¾	3	3¼		
On patent winder	....	....	3	3½	....	....	....	....	....	....	....
Skein yarn, spooler on:											
Single gray cotton	3½	5	6¾	7½	9	10½	11½	13	....	....	....
Two-ply gray cotton	2½	3¼	4½	5½	6	7	8	9	....	....	....
Single colored cotton	10	12	14	16	28	30	32	34	36	....	....
Two-ply colored cotton	4½	5½	6½	7½	8½	9½	10½	11½	....	....	....
Single colored wool	....	10	17	19	21	....	....	....	....	....	....
Two-ply colored wool	7	8	9	10	11	12	13	14	....	....	....
Skein yarn, rewinder on:											
Single colored cotton	2½	3½	4	5	5½	6	6½	7	....	....	....
Two-ply colored cotton	1¼	1½	2½	3½	4	4½	5	5½	....	....	....
Single colored wool	....	2½	3	4	5	6	7	....	....	....	....
Two-ply colored wool	....	....	1½	2½	3½	4	4½	....	....	....	....

Thread numbers	2.35	2 40	2 50	2/60	2/70	2/75	2/80	2/85	2/90	2/100	2/140
Thread:											
Spooling gray skein thread	7	8	9	10	13	16	18	20	21	23	27
Spooling colored skein thread	11	12	13	14	25	27	29	30	32	35	43
Rewinding gray threa i onto cheeses	1½	1½	2	2½	3	3½	3½	3¾	4	4½	5½
Rewinding colored thread	3	3½	4	4½	4½	4¾	5	5½	5½	6	7
Rewinding lisle skeins onto cheeses	....	8½	9½	10½	11½	12½	12½	13	13½	14½	16½
Spooling silk	....	....	12	13	14	....	15	....	16	17	18

LEG MACHINE.

[Wages in pfennigs, per dozen pairs.]

Gage	30		33			36				39		42	48	2.1 rib.	1/1 rib
Divisions	8	12	12	16	18	8	12	16	18	8	12	18	8	12	12
Women's gray cotton hose:															
With extra loose instep	55	37	45	37	32	76	56	45	40	95	73	55	137	65	70
Extra close knit	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Children's hose, all sizes less than women's	....	5	5	....	....	....	5	....	....	10	....	....	....	10	10
Short-leg stockings	10	5	5	5	5	10	5	5	5	10	5	....	....	5	5
Extra for long tops:															
In cotton	....	8	....	....	....	....	....	....	....	....	....	....	....	....	....
In wool	....	9	....	....	....	....	....	....	....	....	....	....	....	....	....
In lisle thread	....	10	....	....	....	....	....	....	....	....	....	....	....	....	....
With knee cap	....	3	....	....	....	....	....	....	....	....	....	....	....	....	....
Gray and natural wool and gray thread over cotton lache	5	5	5	4	4	5	5	4	4	5	5	4	10	5	5
Extra compensation for very fine numbers	5	5	5	5	5	5	5	5	5	10	10	....	50	10	10
Clerical wool and colored feet and rows, extra	12	12	12	12	12	12	12	12	12	12	12	12	80	12	12
Extra marking:															
When with striped apparatus	3	3	3	3	3	3	3	3	3	3	3	3	3	....	....
Without apparatus	3	3	3	3	3	3	3	3	3	3	3	3	3	....	....
Heel and toe cap of wool and colored, extra	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Under two dozen, extra	20	20	20	20	20	20	20	20	20	20	20	20	20	....	....
Two dozen or more	15	15	15	15	15	15	15	15	15	15	15	15	15	....	....
Kneecap, extra	....	5	5	....	....	....	5	5	....	5	....	....	....	....	....
Reenforced seam, extra	....	....	4	3	3	4	4	3	3	4	4	3	4	....	....
15 to 1 drop stitch, extra	25	25	25	25	25	25	25	25	25	25	25	25	25	....	....
Group drop stitch, extra	40	40	40	40	40	40	40	40	40	40	40	40	40	....	....
Extra wide	....	....	....	....	....	10	10	10	10	10	10	10	10	....	....
Opera lengths	....	....	....	....	....	....	....	20	20	20	20	20	20	....	....
Size marks with the hand, per row extra	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Lot of 4 dozen or less, extra	10	10	10	10	10	10	10	10	10	10	10	10	10	5	5

RUNNING ON FRENCH FOOT.

[Wages in pfennigs, per dozen pairs.]

Gage	30	33	36	36	36	39	48
Divisions	12	12	12	16	18	18	8
Gray, cotton foot:							
8 to 12 inches	10	11	12	15½	15½	16	50
4 to 7½ inches or less	1	.....	.....	.....	.....	.....	.....
Gray and natural wool and gray thread over cotton	2	2	2	2	2	2	4
Woven with merino, extra	1	1	1	1	1	1	1
Clerical wool (dark-gray mixture) and colored over gray	2	2	2	2	2	2	11
Woven with split, extra	2	2	2	2	2	2	.....
Striped over plain	2	2	2	2	2	2	.....
Woven with drop stitch, extra	2	2	2	2	2	2	.....

FRENCH FOOT MAKER.

[Wages in pfennigs, per dozen pairs.]

Gage	30	33	36	36	36	39	48
Divisions	12	12	12	16	18	18	8
Gray cotton sock, foot 9 to 12 inches	22	24	27	18	16	18	23
Gray cotton, woman's, foot 8 to 10½ inches	18	20	23	14	12	14	23
Gray cotton, child's, foot 4 to 9 inches:							
With 1 assistant	15	19	20	.....	.....	.....	.....
With 2 assistants	.....	16	.....	.....	.....	.....	.....
Foot with long border, extra, with 1 assistant	.....	7	7	.....	.....	.....	.....
Gray and natural wool and gray thread over cotton	2	2	2	2	2	2	9
39-gage to 36-gage goods, extra	.....	.....	2	2	2	.....	.....
Extra compensation for very fine numbers	.....	.....	10	6	5	.....	.....
Clerical wool and colored, extra	4	4	4	3	3	3	13
1 30 and 1 36 clerical wool, extra	.....	5	.....	.....	.....	.....	.....
Heel and toe cap from wool and colored, extra	3	3	3	3	3	3	
Striped over plain	10	10	10	.....	.....	.....	.....
Half sole, extra	3	3	3	2	2	2	3
Split sole, including heel and toe cap, extra	6	6	6	6	6	6	.....
15 by 1 drop stitch, extra	8	8	8	.....	.....	.....	.....
Group drop stitches, over plain	16	16	16	.....	.....	.....	.....
Size marks, extra	1	1	1	1	1	1	1
Lot of four dozen or less, extra	5	5	5	5	5	5	.....

HEELER.

[Wages in pfennigs, per dozen pairs.]

Gage	24	30	33	36	39	42	48	Ribbed. 2 1	Ribbed. 2:1
Heel and toe, either gray or white	8½	9½	10	11½	13	14	18	7	7
Silk thread over gray	.....	.....	1	1	1	1	.....	.....	.....
Colored over gray, also gray with colored toe	4	4	4	4	4	4	4	4	4

SEAMING.

[Wages in pfennigs, per dozen pairs.]

Gage	30	33	36	39	42	48
Gray cotton and stocking thread:						
French foot, 00-0	10½	11½	12½	13½	.....	.....
French foot, 1-2	12½	13½	14½	15½	.....	.....
French foot, 3-4	14	15	16	17	.....	.....
French foot, 5-6	15	16	17	18	.....	.....
8-10 inches	17	18	19	20	.....	30
Silk thread over gray	1	1	1	1	.....	1
Wool thread over gray	2	2	2	2	.....	2
Colored thread over gray	6½	6½	6½	6½	.....	6½
Goods with heel and toe cap, extra	2	2	2	2	.....	2
Striped over plain	5	5	5	5	.....	5
Opera lengths long knitted stockings	5	5	5	5	.....	5
Gray cotton and loose thread:						
French foot, 4½-5½ inches	9	10	11	.....	.....	.....
French foot, 6-7 inches	10	11	12	.....	.....	.....
French foot, 7½-8½ inches	11	12	13	.....	.....	.....
French foot, 9-12 inches	11	12	13	14	.....	19
Wool over gray	1	1	1	1	.....	1
Colored over gray	2	2	2	2	.....	2
Goods with heel and toe, extra	2	2	2	2	.....	2
Striped over plain	3	3	3	3	.....	3

Some of the Saxon knit-goods manufacturers are very advanced in their plans for ameliorating the condition of their help, and besides giving the boys time off to attend technical instruction, as required by law, they also have courses of instruction for the girls and women in household duties, including cooking and sewing classes, and besides night classes some factories give the girls a few hours off each week to attend such classes in the daytime, the teachers also being paid by the factory. Most of the factories provide a lunch room, with tables and chairs, where the employees can eat their lunch, and many furnish food at cost in such places.

[Several photographs showing a typical Chemnitz knitting mill, groups of operatives, and some of the hosiery machines used accompanied Mr. Clark's report and are on file in the Bureau of Manufactures.]

REPORTS FROM CONSULAR OFFICERS.

AIX LA CHAPELLE.

WAGES, FOOD PRICES, LIVING CONDITIONS, OPERATIVES AND MACHINERY.

Consul Pendleton King furnishes the following information relative to the textile industry of Aix la Chapelle, in Rhenish Prussia:

There are many different kinds of cloth-making machinery used in this district, some of them peculiar to the district; the old kinds have mostly been replaced, within the last five years, by improved machines of Saxon, Belgian, English, and French patterns. Wool-washing machines, called here leviathans, came formerly mostly from Belgium, but now come mostly from Saxony.

Combing machinery is from Muelheim-am-Rhein and Manchester. The older carding machinery is of local, Belgian, French, or English manufacture, but the improved kinds are of Belgian and German (Saxony) manufacture. The older mule-jennies are of Belgian and English manufacture, but they are being mostly replaced by automatic Saxon machines.

The worsted yarn mills mostly have crempel and carding machinery of Belgian manufacture. Leather and cotton wire cards and crempel machines are of Aix la Chapelle manufacture.

Spinning machines (excepting some old machinery of local, English, and Belgian factories) are now of the newest improved types, a large proportion of which are made in Germany and England. A new kind introduced in this district within a few years is the pipe-spinning machinery, the so-called "metiers" of Belgian manufacture.

Gluing, spooling, and warp making and drying machinery are used of various makes, some Belgian and some German; the newest kinds are from Silesia and Saxony. A great variety of looms, mostly of the Jacquard harness or cardboard type, of English, French, Belgian, Swiss, and local make, some of them over twenty years old, are used in this district.

SPEED OF MACHINES—OPERATIVES PER MACHINE.

Slow looms of 50 to 105 shuttle movements a minute, most of them having a speed of 80 to 105, are used, but they are being gradually replaced by the highly perfected mechanical looms of Saxony. More than 40 per cent of all the looms bought in the last three years were of Saxony manufacture. These Saxon looms are of an improved Jacquard type, with harness or pasteboard cards, and a perfected contrivance for lifting and depressing the warp for the passage of the shuttle and drawing the threads; they are heavy high-speed machines, making between 150 and 180 shuttle movements a minute, and are mostly sold on the installment plan; 15 per cent is generally paid on delivery, and the rest in yearly installments of 20 per cent. Such high-speed looms

are sold in this district, mounted and set in motion, at from $200 to $300 each.

Besides the looms mentioned, Belgian and English looms are running in this district.

Cloth shearing, bleaching, dyeing apparatus, and stretching machines are all of German manufacture. Fulling machines and carding machines are the product of Aix la Chapelle. Bobbins, spindles, and shuttles are of German manufacture, but some of Dutch manufacture are also in use.

No machines for woolen cloth are in use here where one operative tends more than one loom. The introduction in one mill, some two years ago, of the two-loom system (i. e., one operative tending two looms) met such opposition from the Weavers' Union that the manufacturer stopped using them.

WAGES AND LIVING CONDITIONS OF OPERATIVES.

The wages in the Aix la Chapelle woolen mills are as follows: The foreman of the spinning department (spinning master) from $9 to $14, the operatives from $5 to $6, and the other help, mostly girls, from $4.50 to $5 per week.

The foreman of the weaving department (weaving master) from $9 to $14, and the regulators or setters from $7 to $10.50 per week. Weavers are paid $5 to $9 per piece, and if capable and diligent can finish 1½ pieces of 40 meters (43.6 yards) at $5 or 1 piece at $9 each week. They earn, on an average, from $1 to $1.40 per day.

The darning of pieces is done by women and girls. The mistress of the darning department receives from $8 to $10 and her assistants from $5 to $7 per week.

The working hours are somewhat variable; generally they run from 7 a. m. to 12, and from 1.30 to 7 p. m.; married women or girls with families are generally allowed to quit work at 6.30.

More than 25 per cent of the factory operatives of Aix la Chapelle have their homes in Holland, whence they come each morning (some as far as 30 miles) and return each evening. For this they pay 75 cents a week for the "workmen's railroad ticket." They mostly own little houses with ¼ to 1 acre of garden or field. They have a cow and a few pigs or keep some goats, and bake their own bread. They are allowed a few days off each year to till their fields. They manage to live very cheaply; a family of father, mother, and four children will live on 60 cents a day. Flour is 20 per cent and meat 25 per cent cheaper in Holland than in Aix la Chapelle. Most of those country home dwellers have a savings bank account or deposit of a few hundred dollars. They are an honest, economical people, and the most reliable of the factory operatives. Much the same may be said of a further 15 per cent of the operatives, who live in German villages around the industrial cities of this district. These also mostly own little houses and fields, or pay $12 to $14 rent per year for such. They are generally able to take to farming occupations when factory work becomes scarce.

The life of the textile workmen dwelling in the city is not so favorable. The cost of living is very high in this city and in towns of this consular district.

In this city (the principal center of the cloth industry of the district) one-fourth to one-fifth of the wages of a weaver is needed for rent; a family generally pays for two rooms $4 to $6 a month.

COST OF LIVING.

The retail prices of foodstuffs and other necessaries of life in Aix la Chapelle are as follows:

Description.	Per pound.	Description.	Per pound.
Foodstuffs:	*Cents.*	Foodstuffs—Continued.	*Cents.*
Beefsteak	27 to 30	Butter	10 to 12
Other parts of beef	20 to 25	Cream butter	35 to 40
Ham	40 to 55	Eggs—	
Sausage	10 to 30	In winter	24 to 42
Pork	20 to 25	In summer	24
Horse meat, used by many workmen's families	10 to 12	Black rye bread, of coarse, crushed rye and refuse flour, 4-pound loaf	12 to 14
Flour—		White bread 1-pound loaf	4 to 6
Prime	5 to 6	Milk per quart	5 to 10
Second quality	4 to 5	Other necessaries of life:	
Third quality	3 to 4	Coal per 100 pounds	40 to 55
Potatoes	1 to 2	Kindling wood do	45 to 55
Dried Bosnian prunes	6 to 8	Workmen's shoes, heavy nailed, per pair	125 to 225
California prunes	15 to 18	Workmen's labor suit, blue Nankin	150 to 200
Cheese—		Ready-made suit, of artificial wool or threaded	300 to 800
From skimmed milk and the refuse from margarine butter	10 to 12		
Best cheese	20 to 30		

While milk costs from 5 to 10 cents per quart, it is furnished free to the families of workingmen who have several children, and for less than half price to others whose ability to pay is limited, on a certificate of the family physician stating the circumstances.

The children of workingmen are also taken out once a week during the summer by their teachers, and are then given bread and milk free of charge. The workingmen of the better class generally belong to a singing or other club, and many of them raise pigeons, rabbits, etc.

There is also a benevolent institution where the wives of workingmen, at times of confinement, can remain three weeks, for from $3 to $5. Children from 2 to 6 years old can go to a kindergarten during the day until the mothers return from the mills. There is also provision made for the industrial education, in industrial schools, of children of workingmen whose means may be limited.

[On the whole, the children of the workingmen do not present a appearance; they are not poorly clothed, and look healthy. ples of cloth manufactured in Aix la Chapelle, which accom- d Consul King's report, are on file for inspection in the Bureau nufactures.]

BAMBERG.

INDUSTRIAL ACTIVITY IN COTTON MILLS—WORKMEN'S HOMES.

ul William Bardel states that there are about 20 cotton mills consular district, the largest giving employment to He adds:

The wages paid to foremen are from $47.60 to $83.30 a month; workingmen under 16 years of age receive from $2.18 to $2.86 a week; those over 16 years old from $4.28 to $7.14 weekly. Women over 16 years old earn from $2.15 to $3.15, while those under this age receive from $1.71 to $2.15 a week. Sixty-one hours constitute a working week. The cotton mills spin thread out of American good middling. They weave shirting and sheeting muslin exclusively. The majority of the machines are tended by one operative.

The cotton-mill owners have built a number of workingmen's homes for their operatives, which they rent to them for $23.80 to $47.60 a year. Other necessary requirements cost between 31 and 48 cents a day.

BRESLAU.

OUTPUT OF THE MILLS, AND WORK AND WAGES OF THE OPERATIVES.

The following information concerning the textile mills of Silesia and the labor conditions prevailing therein is furnished by Consul Herman L. Spahr, of Breslau:

There are in Silesia about a dozen large establishments engaged in the linen industry, and quite a number of smaller mills. The average wage paid in these is as follows, per week, of ten hours per day, and running three hundred days per year: Overseers, 24 marks ($5.71); male operatives, 15 marks ($3.57); female operatives, 9 to 10 marks ($2.14 to $2.38).

The machinery used, steam engines, turbines, looms, Jacquard machines, and preparing machines, are mostly of German make, but some are of English origin. The largest weaving mill in the district makes almost exclusively figured linen goods, such as tablecloths, napkins, and towels, and table covers in white and colors, plain and embroidered.

As a rule one operative tends one machine, seldom two, as the articles manufactured require close attention. In spite of the apparently small pay, the majority of employees are able to keep up the household and save something, without even strict self-denial. Often several or all members of a family are employed in the factory, and thus the family can live well. Where there is a number of young children, living is more difficult, especially when the head of the family for any reason is incapacitated for steady work; but such cases are exceptions, and are generally ameliorated by charity.

WELFARE WORK.

In addition to the welfare provisions required by law, the following endeavors of the owners to better the condition of their operatives may be mentioned. There are savings banks paying 5 per cent, with yearly deposits of about 50,000 marks ($11,900); soup and coffee kitchens charging 3⅓ pfennigs (0.8 cents) a portion; bath houses where a bath costs 3⅓ pfennigs; infirmaries for free nursing and treatment; a fund for convalescent workmen, and another for the care of feeble children. Widows and aged workmen receive pensions or an extra allowance, besides the age and invalid pensions fixed by law. One mill reports that in 1907 the sum of 29,000 marks ($6,902) was set aside for dwelling improvements.

The owner of a large weaving mill reports that the workmen enter his service usually as soon as they leave school, and frequently remain through life. Many of them have been in the mill thirty or forty years. Intelligent and industrious employees are promoted from time to time. Outsiders are seldom employed, but workmen once employed are never thrown out of employment against their will, when hard times set in. Their income, if not large, is at least, to a certain degree, secure.

COTTON MILLS.

The cotton mills in Silesia number about a dozen for spinning and a score for weaving. In the former overseers get from $5.36 to $7.38 weekly; male operatives average 55 cents daily, and female operatives 48 cents. The spinners work ordinarily ten hours a day, the weavers ten and one-half hours. Children under 14 years must not be allowed to work over six hours a day, three in the morning and three in the afternoon. The machinery is principally of English and German make. The finished products include staple articles and bedding, aprons, inlets, coarse goods (flannels, etc.), also dress goods, zephyrs, etc. One operative attends to one machine, perhaps two, and in exceptional cases three. This is in the main due to the scarcity of labor, leading often to the employment of unskilled workmen. Food is usually furnished at low prices. For instance a group of five mills (one spinning, four weaving) belonging to one firm, maintains canteens, at which a meal is sold for 20 pfennigs (4.8 cents) and, at the coffee hour, one-half liter (1.3 pints) of coffee with two rolls, for 5 pfennigs (1.2 cents). Bath houses, kindergartens, and hospitals are also established. The cotton mills employ 3,200 workmen, who run 2,658 looms in the four weaving mills and 29,500 spindles in the spinning mills. [Samples of linen, cotton, and union goods made in the foregoing mills are on file in the Bureau of Manufactures.]

CHEMNITZ.

A BUSY INDUSTRIAL AND COMMERCIAL CENTER.

Consul Thomas H. Norton, writes that Chemnitz is especially well provided with technical schools for training in the various industries, and especially for the textile trade. He continues:

The cotton goods, especially stockings, for which the place is mainly celebrated, rival those of England in quality and cheapness. It is also famous for the manufacture of spinning machinery. There are numerous establishments for the weaving of woolen and half woolen cloths, and the stocking weaving is prosecuted by a large number of firms. The dye works, paint works, bleach works, and chemical works employ a great number of workmen and carry on a large trade.

Hundreds of thousand dozens of knit gloves are purchased here annually by buyers from every country in the world. In the surrounding district the ceaseless noise of the knitting machine is heard in every home. The export trade is very extensive. The principal ar-

ticles of exports declared at Chemnitz for the United States during the calendar year 1906 were:

Articles.	Value.	Articles.	Value.
Underwear	$181,850	Gloves:	
Machinery	277,190	Cotton	$1,852,620
Hosiery:		Silk	668,440
Cotton	7,038,910	Wool	272,190
Silk	236,495	Other articles	658,245
Wool	61,570		
		Total	11,247,510

VARIETY AND VALUE OF THE OUTPUT.

The great prosperity of the hosiery trade is largely due to the good demand manifested by the United States. Lisle-thread goods, of which a dozen of ladies' stockings only weigh 1¼ pounds, are becoming largely sought. As regards fancy styles, lace openwork goods still lead in this market, and there is also a large demand for hand embroidery on hosiery. Kid gloves are largely manufactured, but this particular line has been affected by the popularity of silk and lace gloves. Golf and Scotch gloves are also a popular feature of this market. In laces the demand is good for guipures, nets, and galloons. Another important line is that of dress fabrics, such as jacquards, serges, armures, and grenats. The trade in upholstery goods, plushes, etc., is also in a flourishing condition.

Germany has almost obtained a monopoly in the cotton knit goods trade in the United States, the exports thither amounting to $6,150,484 in 1905, $7,128,897 in 1906, and $8,671,848 in 1907. The principal supply for these goods was Chemnitz. The number of spindles in Saxony has increased from 740,000 to 1,430,000 in twelve years. The total in the German Empire is now 10,000,000.

CREFELD.

WAGES GRADED ACCORDING TO SKILL OF OPERATIVES.

Consul Joseph E. Haven furnishes the following information from Crefeld:

There is no recognized wage scale in force in the silk and velvet mills in this district, each manufacturer having a standard of his own. The wages vary in the different departments, according to the skill of the several workmen. In the weaving department overseers receive from $5.95 to $7.14 a week, while laborers are paid from $5.71 to $6.18. In a few factories wages are paid according to piecework. Overseers in the winding and warping departments receive from $5.95 to $7.14 weekly; the laborers from $3.57 to $4.96. The employees in these departments are generally women. In the dyeing department overseers are paid $9.52 to $10.71, skilled labor from $7.14 to $8.33, and unskilled labor from $4.76 to $5.95. The overseers in the finishing department receive $8.33 to $9.52, and the laborers from $4.76 to $6.18.

The machinery used in the several factories is principally of German manufacture, and the classes of textiles manufactured are silks, half silks, velvets, and cotton yarn. The operatives in the larger

towns have their houses in which several families reside, while those in the country each have a cottage and usually a small plat of ground. [Samples of silks, half silk, and other textiles are filed for inspection in the Bureau of Manufactures.]

DUSSELDORF.

SPECIAL LINES OF TEXTILE INDUSTRY—GIRL APPRENTICES.

Consul Peter Lieber, writing from Düsseldorf, says that the textile industry of Germany is divided into two principal branches, spinning mills and weaving mills, comprising two special lines, those working silk and those working cotton. The consul adds:

In spinning mills, where only women are employed, the average daily wage is from 71.4 cents to 83.3 cents. Immediately after leaving school, usually at 14 years, the young girls enter the factories. In two years they earn from 35.7 cents to 47.6 cents a day, and after four or five years their wages are increased to the maximum of 83.3 cents. In weaving mills the salary undergoes many fluctuations, reaching as high as $1.19 per day. There are also many factories where workers are paid according to what they produce, and often make as much as $1.30 a day.

The weaving mills in Düsseldorf employ mostly German machines; in some cases French machines are used. In several other places American and English machines are in use, which are by no means inferior to the German machine as to their capacity and mechanical construction. [Samples of silk and other fabrics made in the Düsseldorf region are filed for inspection at the Bureau of Manufactures.]

EIBENSTOCK.

CONDITIONS AND WAGES IN THE COTTON KNIT-GOODS INDUSTRY.

Consul William C. Teichmann, of Eibenstock, reports that the most important textile industry in his district is the manufacture of cotton hosiery and underwear, with embroidered trimmings ranking second, concerning which he writes:

The knit-goods industries are located chiefly at Gornsdorf and Thalheim. At Gornsdorf twelve factories, all producing hosiery, had been doing a prosperous business until the American financial flurry of last fall and the inauguration of a protracted strike changed these conditions unfavorably. This strike revealed the wage scale, so that a description of wage conditions, otherwise difficult to obtain, can be given.

The five firms originally affected by the strike employed 472 men and 209 women workers, with weekly wages amounting to $3,351, averaging $4.92 per person a week. Of the men, 65.3 per cent earned more than $4.76; 55.6 per cent more than $5.36, and 42.9 per cent more than $5.95. Of the male employees, 154 received $6.43 and over; 80 more than $7.14, and 14 over $8.33. The highest wages paid the men ranged from $8.64 to $10.13.

The total annual wages earned by some families through their several members exceed $1,500. The normal number of hours of

work for these wages was fifty-eight per week, averaging a little less than ten hours per day. The wage scale given includes all working people, even boy and girl apprentices and operatives. On the whole, these scales are high for Saxon factory labor and are due to the rapid expansion of the Saxon textile industries in recent years, the dearth of labor for the supply of industrial demands in general in Saxony, as well as for German agricultural requirements, and the tendency of the employers to grant the steady increase in wages enforced by labor in the industries during the recent economic prosperity.

These wage conditions are also applicable to the hosiery factories at Thalheim, where 45 establishments manufacture cotton stockings principally. It is claimed by manufacturers there that the average wage paid the skilled stocking worker of this section amounts to $7.14 per week, and that $9.52 is nothing unusual.

THE MANUFACTURE OF EMBROIDERED TRIMMINGS.

The manufacture of embroidered trimmings ranks second in importance in this district, and is still conducted by two somewhat different means—the schiffli (or schiffchen) embroidery machine, with pantograph attachment, and the hand machine. Since its invention in 1860 the schiffli machine has been steadily improved, so that it can be used for various kinds of mull muslin and tulle (net) lace in large pieces, upon which 1,800 stitches a minute are embroidered by automatic process. A stitcher at the left of the loom guides the pantograph over the sixfold enlarged pattern outlining the stitches. Special appliances attached to the machine produce particular ornamental stitches, sew on braids and cords, and even enable several chain-stitch seams to be made with one thread. All kinds of textures and tulle can be embroidered. Gold and silver threads can also be used. Robes, stripes, trimmings, insertions, blouses, shawls, aprons, parasols, petticoats, cloths, etc., can thus be embroidered; also velvet, table covers, portieres, lambrequins, upholstery materials, and even rubber belts for the sporting-goods trade.

A recent invention which may revolutionize the colored embroidery process is an attachment supplied with boxes, each containing a certain color. In order to produce differently colored stitchings the threaded needle is passed through the required color and the thread thus colored at will. The rollers which conduct the thread are supplied with a heating appliance to produce rapid drying. The color change operates smoothly and can be made in a few minutes. The colors can always be supplied by the color factory, so as to insure strict uniformity when quick renewal of supplies is needed. Cotton, silk, artificial silk, etc., can all be worked in any genuine color. Guipure lace can thus be made without difficulty. [The product of this innovation is shown by two samples inclosed, which are on file in the Bureau of Manufactures.]

HAND MACHINES USED IN SMALL ESTABLISHMENTS.

There are ten establishments manufacturing embroideries by the schiffchen machine. However, the hand machine is much more in use here, more than fifty establishments preferring the latter. They are smaller concerns and are not conducted on the same extensive

scale as in Plauen and also at St. Gall, in Switzerland, at which places the manufacture is confined to that by the schiffchen machine.

The hand embroidery machine is a "satin-stitch" machine, smaller than the schiffchen machine, and operated by a hand crank between the pantograph and the stitching apparatus. The hand machines used in Saxony have on each carriage side two or three rows of needles. The two-rowed variety is known as the Swiss type, and the three-rowed is termed the Saxon machine. A special contrivance has been invented, whereby the needles are not only threaded, but the threads are knotted. This appliance can be arranged to stitch on a pillow, the replacing of the pillow being the only manual work required. One girl can operate four or five such machines at a time. The machine can thread 25,000 needles daily.

The general advantage of the latest automatic schiffchen machine, both in cost and operation, is that it produces 25 to 30 per cent more stitches than the ordinary schiffchen machine. Another advantage is that larger pieces can be worked, because the machine has a length of 20½ feet, whereas the ordinary schiffchen machine's length is about one-third shorter. The ordinary schiffchen machine works from six to ten times as fast as the hand machine.

OPERATIVES SCARCE AND WAGES HIGH—COST OF LIVING.

The prosperous conditions of the the past few years have not only reduced the supply of operatives by constant absorption, but organization has forced up wages steadily. A few years ago stitchers for the embroidery industry could be had for $4.50 per week; now they average $6 to $7.10. The watchers, or "aufpasser," usually women, who attend the machine and look after its operation while the stitcher guides the pantograph, receive from $2.40 to $2.85. The working hours in summer are from 6 a. m. to 7 p. m. The stitcher is not compelled to work uninterruptedly, as he is paid about 57 cents per 1,000 stitches. Some stitchers have their own machines and receive better pay, averaging from $9.50 to $11.50 per week. One stitcher and one watcher suffice for the operation of a machine, although two watchers insure a better supervision over the apparatus and are frequently employed.

Much of the work, like cutting off and fastening the threads, is performed by the home workers, principally by women and children, who become so adept in the handling of the scissors and thread as to earn from 15 to 20 pfennigs (3½ to 5 cents) per hour.

As to the style of living, the better times of recent years have enabled the working people here to buy more meat and vegetables than formerly. To many meat was a rare luxury, and potatoes and bread their principal nutrition. Potatoes are still the main food, and many operatives have leased small potato patches in the neighborhood of Eibenstock from farmers, who turn the patch over to them when the potatoes are ready for digging. The patches are just large enough to furnish a yield sufficient for the family of the renter.

The cost of living has increased materially here within the last decade for the middle and upper classes, but not so much for the working people, whose income has not only correspondingly been increased, but, owing to the great demand for labor and the frequent scarcity in industrial as well as agricultural quarters, achieved gains exceeding the difference in increased household expenses.

At Kirchberg, Wilkau, and a few other towns in this district spinning and weaving mills and cloth manufactories exist, but the manufacturing and wage conditions there are similar to those prevailing in the adjacent Plauen district, which have been fully covered in reports from that section.

FREIBURG.

MACHINERY AND PRODUCT OF THE MILLS—WAGES AND LABOR CONDITIONS.

Consul E. Theophilus Liefeld furnishes the following information concerning the textile industry in the Freiburg consular district:

All the ordinary kinds of textiles are manufactured here, among the principal lines being women's and men's woolen garments and silk and half-silk goods. One firm makes artificial silk and horsehair.

Another firm is engaged in the manufacture of ramie yarn and ramie goods. This firm is constantly adding to its large factory, and expects to be able to turn out, in a short time, 1,300,000 pounds of ramie yarn per year. The fiber used by this firm is imported from China, where it is grown on the high plateau of the Yellow River. Members of this firm inform me that in their opinion ramie can be successfully cultivated in the Philippines.

During the year 1907 there were exported from the consular district of Freiburg to the United States textiles to the value of $481,885, which was 34 per cent of all exports declared at this consulate. There were in all 788 invoices of textile goods certified to, which was 44½ per cent of the total number for the year.

MACHINERY AND ITS OPERATION.

Much of the machinery in use is of German manufacture, but Swiss, French, and British machinery is also in use. An Alsatian factory furnishes the manufacturers here with considerable spinning and weaving machinery. One of the largest Freiburg firms informs me that its principal machines, especially sewing machines, are of American manufacture.

As the speed varies with the different machines, accurate figures for the respective machines can not be given. I am informed by one firm that the speed is from 80 to 120 revolutions per minute; another reports a velocity of 180 revolutions per minute for certain spinning wheels in his factory, for steam-power machines from 80 to 150, while dynamos and sewing machines have even 3,000 revolutions per minute.

In a great many cases there is one operative for every two or three spinning frames, and for sewing machines one woman for each, while for looms one women operates one to two machines—in all factories a great many of the operatives being women. In some factories, however, one operative tends four weaving machines.

HOURS OF LABOR AND WAGES.

The hours of labor in the mills average about ten per day. At one mill, for example, the working hours were from 6 to noon and from 1 to 5 p. m., with fifteen minutes recess in the forenoon. An Alsatian factory reports the hours of labor as ten and one-half in summer,

with fifteen minutes recess, ten and three-quarters in winter, with thirty minutes intermission. The winter hours are from 6.15 a. m. to 12 noon and from 1 to 6 p. m. Two factories here in Freiburg report their hours of labor ten and one-half per day.

Ordinary laborers in the mills are paid from 48 to 71 cents per day, their overseers from 71 cents to $1.20, while skilled laborers are paid as high as 95 cents, and their overseers $1.67.

That some of the mills are run on a cooperative plan is evident from a recent newspaper report, which states that a textile factory in this district at the close of the year divided $7,140 among its employees, those who had been in its employ more than five years receiving Christmas presents of from $2.40 to $19.

I am unable to learn anything definite about the cost and manner of living of the operatives. One of the firms informs me that their employees usually pay more attention to dress and board than to the comfort of their living quarters. Some spend all their earnings, while others, more economical, save something.

WORKINGMEN'S DWELLINGS.

In several cases where there are a great many employees suitable houses, especially intended for the operatives, have been erected, so as to rent reasonably, and they are generally in great demand. This is the case at Emmendingen, and it is also especially the case in the city of Mülhausen, Alsace, which belongs to the Freiburg consular district, a great industrial center of textile manufactures, with a population of about 100,000. Mülhausen has a workingman's section, where the Industrial Society of Mülhausen has built plain, comfortable houses, and sold them at a low price, really at cost, to the laborers, charging a certain amount monthly, which payments, being regularly made, would, in the course of time, pay all the original costs of building, together with a suitable amount of interest, when the houses would become the property of the occupants. In the year 1901, 1,243 such houses were owned by the occupants, and the recent reports of this society show that it is still active in building such suitable dwellings, and either renting them or selling them, somewhat on the plan of the building and loan associations of the United States.

From the report of 1903 I learn that this society appropriated $26,656 for the purpose of erecting new dwelling houses for workingmen. The recommendations of the committee as to the new buildings were that two kinds of dwellings be built, one with apartments containing two rooms and a kitchen, the other with three rooms and a kitchen, with all necessary adjuncts as to sanitation and comfort provided for, and that the dwellings of two rooms and the kitchen should pay an annual rent of $34, and the one of three rooms $46.

COST OF HOUSES AND METHOD OF PAYMENTS.

Accordingly, from the spring of 1901 to the summer of 1902 the houses containing 12 two-room and 12 three-room apartments were built at a cost, land included, of $1,064 each for the two-room dwellings, and $1,153 for the three-room dwellings. The rents were fixed as follows, not including gas and water: Two-room apartments, ground floor, $2.86 per month; for the first and second floors, $3.09

per month; three-room apartments, ground floor, $3.70 per month; and for first and second floors, $4.17 per month. On September 1, 1902, these apartments were all occupied, housing 137 people, including 83 children.

From the purchase contract it is evident that the purchaser is expected to pay down 10 per cent of the purchase price and a further 10 per cent each year until the place is paid for. This would mean a rent of $5.71 monthly for a house, the value of which is $685.44, and $9.52 monthly for a home worth $1,142 or more. If for any reasons the monthly payments are not made and it seems that the party can not or will not pay, then the society can order the occupant to leave the premises, for, according to the contract, the purchaser is considered as living as a renter until the place is paid for. In such a case a certain amount of the money paid is returned, for the monthly dues were considerably higher than the amount that would have been charged as rent.

[A number of samples of textiles, ramie products, stalks, crude bark, prepared fiber, and thread, and plans of workmen's dwellings, transmitted by Consul Liefeld, are on file in the Bureau of Manufactures.]

GLAUCHAU.

PRODUCTION OF NOVELTIES—TECHNICAL TRAINING OF OPERATIVES.

Consul George A. Bucklin, jr., advises that Glauchau stands preeminent in the production of certain fabrics, from the fact that its manufacturers have always striven to produce complicated novelties, concerning which he writes:

These can be produced here better than almost anywhere else, because the old staff of hand weavers are people of great technical knowledge, and all of the help, such as spinners, dyers, and finishers, have adapted themselves to producing novelties and to overcome almost any difficulty in the way of new creations. Furthermore, Glauchau has a state weaving school, with some very practical and experienced teachers, so that there is always a supply of technically educated help. In fact, men, women, and children are imbued with everything that is connected with weaving goods.

The welfare of the city is dependent upon the weaving industry and upon those industries connected with it. Out of a population of 25,000 inhabitants about one-half are directly interested in the textile industry and about one-fourth more are indirectly dependent upon it, in such work as spinning, dyeing, spooling, making of winding boards, cases, and dealing in paper used for putting up the goods.

The number of firms in Glauchau at present engaged in the textile business is about 10, and these engage (not counting the help for weaving the goods) about 1,000 employees. The value of the output of the largest manufacturer is about $1,500,000 annually. The output of the average factory is perhaps $500,000. The approximate value of the total output of textiles in the city of Glauchau amounts to about $6,000,000 annually, and the foreign countries which are the largest purchasers are the United States, England, and Russia.

HANOVER.

OUTPUT OF FACTORIES, WAGES, HOURS OF LABOR, COST OF LIVING, ETC.

In submitting the following information concerning the textile industry of Hanover, Consul Robert J. Thompson reports that while it is not particularly extensive it is diversified, consisting of wool washing and dressing, cotton spinning and weaving, carpet weaving, etc.:

There is one wool washing and dressing factory in this district employing 1,000 males and 800 females, ten hours constituting a day's work. Every department works with night shifts. The wages are paid semimonthly, with deductions for invalid and old-age insurance. This company furnishes homes to the workers at a nominal rent. Figures charged for rental are not available, but are estimated at $60 per year on an average. Supply stores and a reading room are provided for the employees. The daily wages paid in this factory are as follows (1 mark=23.8 cents):

Description of work.	Males.	Females.	Description of work.	Males.	Females.
	Marks.	*Marks.*		*Marks.*	*Marks.*
Yard work	3.25		Carding	2.25-3.25	
First sorting	3.20	1.90	Combing		2.00
Washing and carbolizing	3.25		Ironing		2.00-2.20
Second sorting	3.20	1.90	Chemical department	3.50	
Second washing	3.25		Inspectors	3.50-4.25	

Business with this company has been very good during recent years, the stockholders receiving dividends of 12 per cent. Wool is bought from Australia, Argentina, South Africa, and from German growers. The wool is sorted, washed, carded, combed, and smoothed. It is then sent to the spinning mills. A special department of the factory is the chemical division, where residues from the other departments are made into wool grease, potash, and artificial manure, Much of this wool grease is exported to the United States.

WEAVERS' WAGES AND MACHINERY.

The wages of foremen working in the principal corduroy and cotton velvet factory vary according to the wages of the male and female weavers working under them, and amount to about 30 to 40 marks ($7.14 to $9.52) per week. Other foremen and the master weavers get fixed weekly wages, varying from 24 to 80 marks ($5.71 to $19.04) according to the ability and the responsibility of the men.

The male and female workers in the weave room and in the shearing establishment do piecework and earn 15 to 28 marks ($3.57 to $6.66) weekly, according to their ability. One workman generally runs two looms; the more skilled run three. The men and women working in other branches of this establishment earn, on an average, about 3.30 marks (79 cents), according to the kind of work they do, per day of 10 hours' work, viz, 6 to 8, 8½ to 12, 1½ to 6—that is to say, 12 hours with 2 hours of rest, as indicated.

In the weave room drum looms are in use, of English and German manufacture. The machines in use in the shearing branch, where

the threads of the weft are cut to form the glossy surface of the velvets, are made in Hanover. Part of the weft is cut by hand. Besides these, a good number of other machines of different construction and make are used. This company makes velvets and corduroys only, samples of which are forwarded. The speed of the looms in use by the company depends on their width and varies between 120 and 170 revolutions per minute. The speed of the machines in the other branches varies greatly and can not be given exactly. The main factory at this place and a branch establishment in the south of Germany belonging to this company, together work 1,850 looms, 250 cutting machines, and 550 finishing and dyeing machines.

COTTON SPINNING AND WEAVING AND CARPET WEAVING.

The leading cotton spinning and weaving factory employs about 800 workers, for the most part women. The wages for spinners are 20 to 28 marks ($4.76 to $6.66) per week, and for helpers from 50 to 75 per cent of this. The self-acting spinning mill and water spinning mill, making yarn Nos. 4–36 and 8–32, respectively, have as tenders women only. The wages are 10 to 15 marks ($2.38 to $3.57) per week, and the same wages are paid in the department for washing, winding, and wrapping. This factory also has 24 houses containing 93 homes, renting at $25 to $40 per year for small apartments of three or four rooms. These houses are old, but there is always a large waiting list of applicants, owing to the cheapness and accessibility of the quarters.

Herat rugs, machine and hand woven, stair carpets, and strips of carpet are manufactured here to a small extent. Self-acting looms are used for carpet weaving, and the knotting is done by hand. Machines have been tried for knotting, but without success. Wages in this line amount to 3 to 3.5 marks (71 to 83 cents) per day for dyers; women and girl workers, tending machines, earn 6 to 13 marks ($1.43 to $3.09) per week.

COST OF LIVING.

The total number of operatives, male and female, is about 1,900, part of whom live in apartments built by the company. The working women are allowed to bring their children to a nursery built by the factory.

The operatives can get meals in special places established for this purpose, and costing 28 pfennigs (6½ cents), each meal containing a liter (1.05 quarts) of meat and vegetables. The houses furnished its employees by this company consist of small stone buildings with two to four apartments of four rooms each—kitchen, living room, and two bedrooms. The rental is 120 to 150 marks ($28.50 to $35.70) per year. Plans of the house are forwarded herewith.

In the children's nursery and hospital, established by this company, about 200 children are taken care of each workday. This establishment has been in existence since 1872, and is for the benefit of mothers who wish to work in the factory, but have no one to take care of their small children. Its staff is composed of doctors, nurses, kindergarten teachers, waitresses, etc. The expense is borne chiefly by the company, in the proportion of 2 to 1. The cost per day per child amounted in 1906 to less than 9 cents, making the outlay for the

mother about 3 cents per day for nursing, feeding, and care of her child. This company pays 7 per cent dividends on its capital stock.

An average income for a male factory worker per year may be fairly estimated at 1,200 marks ($285.60). To this should be added 200 to 300 marks ($47.60 to $71.40), which may be earned by the wife or children. This income will be disposed of generally in the following manner, amounts given for the year being for a family of five: Apartment or flat, 260 marks ($61.88); clothing, 150 marks ($35.70); food, fuel, and light, 720 marks ($171.36); recreation, 100 marks ($23.80); total expenditures, 1,230 marks ($292.74). [Samples of cotton velvets and corduroys, and plans of the houses occupied by factory employees, which accompanied Consul Thompson's report, are on file in the Bureau of Manufactures.]

LEIPZIG.

NUMBER OF WORKERS AND WAGES PAID IN SAXONY'S TEXTILE INDUSTRY.

Consul Southard P. Warner, of Leipzig, states that the importance of Saxony as a textile center is well shown by interesting figures which have been published by the imperial insurance office, from which he compiles the following:

During the twenty years from 1886 to 1905 the number of insured workmen in the German textile industry increased from 473,700 to 732,500, or 55 per cent. In Saxony the number of textile workers increased from 116,000 to 225,300, or 94 per cent. In 1886 Saxony employed about 24.5 per cent, and in 1905 about 30.7 per cent of all persons engaged in textile manufacturing in Germany. The total wages paid in Germany to textile workers increased from $62,118,000 in 1886 to $122,570,000 in 1905. Those in Saxony increased from $14,756,000 in 1886 to $36,652,000 in 1905.

The following table gives the number of insured workmen and the wages paid in the textile industry in each of the six districts of the German Empire for the years 1886 and 1905:

Districts.	Persons insured.		Per cent increase.	Wages paid.		Per cent increase.
	1886.	1905.		1886.	1905.	
Saxony	116,000	225,300	94	$14,700,000	$36,700,000	150
Northern Germany	105,000	124,000	18	13,600,000	21,900,000	61
Rhineland-Westphalia	92,300	138,600	50	13,600,000	27,100,000	99
Southern Germany	64,500	119,200	85	8,300,000	18,300,000	120
Alsace-Lorraine	57,500	67,200	17	8,300,000	11,200,000	35
Silesia	38,400	58,200	52	3,600,000	7,400,000	106
Total Germany	473,700	732,500	55	62,100,000	122,600,000	97

As will be seen from the foregoing statement, Saxony shows the greatest increase in the number of insured workmen and also in the wages paid.

AVERAGE WAGES—BENEFIT OF TEXTILE SCHOOLS.

The average of the yearly wages paid in the German textile industry in 1886 was $128.44. In 1905 the average was $163.66, an

increase of 27 per cent. The following table shows the average yearly wages paid in the six districts for the years 1886 and 1905:

District.	Average yearly wages.		Per cent increase.	District.	Average yearly wages.		Per cent increase.
	1886.	1905.			1886.	1905.	
Saxony	$127.33	$162.79	28	Alsace-Lorraine	144.94	166.36	15
Northern Germany	129.23	176.60	37	Silesia	92.82	126.62	36
Rhineland-Westphalia	147.08	195.87	33	Total Germany	128.44	163.66	27
Southern Germany	129.23	153.75	19				

The textile workmen engaged in the so-called "home industry" are not included in these figures.

In 1895, the figures for the occupation census of 1905 not yet having been published, the number of industrial workers in Germany was 10,270,000, Saxony's share being 1,150,000. The number of persons employed in the textile industry of the Empire was 993,000, or 9.7 per cent of all industrial workers. In Saxony the textile workers numbered 267,000, or 23 per cent of all industrial workers. In 1895 27 per cent of all the German textile workers were employed in Saxony. From these figures can be seen what an important part the textile training schools have played during recent years in the development of Saxony as a textile center. In 1906 the total number of factories in Saxony was 23,000. Of these, 5,300, or nearly 25 per cent, were textile establishments.

MAGDEBURG.

TEXTILE INDUSTRY SMALL—WAGES OF THE OPERATIVES.

Consul Frank S. Hannah reports that the Magdeburg consular district is not a textile manufacturing region, no goods of this description being manufactured for export to the United States, although one or two local exporters purchase small quantities of textile goods from the big manufacturers in the Kingdom of Saxony and ship them to the States. The consul continues:

There are, however, one or two small concerns here engaged in the manufacture of cotton goods, from whom the following information has been obtained: The wages paid overseers are 36 to 50 marks ($8.57 to $11.90) per week. The male mill-operatives receive 30 to 36 marks ($7.14 to $8.57) and the female 12 to 18 marks ($2.86 to $4.28) weekly. These wages are paid and the work done entirely by piecework. The average hours of labor are fifty-nine hours per week, ten hours constituting a day, with the exception of Saturday.

The cotton-spinning machines are made in England and in Alsace. The looms and the machines for coloring are made in Germany and the bleaching machinery in Switzerland.

As the industry here is so small and the number of operatives so limited, a general provision for cheaper rent and the furnishing of supplies at reduced prices, as is sometimes the case with large manufacturing corporations, does not enter into consideration. The majority of the operatives here are girls, who live with their parents under the ordinary conditions prevailing in the local working classes.

MUNICH.

FACTS OBTAINED UNDER DIFFICULTIES—WAGES AND COST OF LIVING.

Consul-General Thomas W. Peters, writing from Munich, Bavaria, says:

Information in regard to textile manufacturing here is very meager, some firms absolutely refusing to give out anything. There are very few shipments, and even these, under the new regulations, are not subject to an expert examination before certification of invoices, as was formerly the case. Manufacturers can and do refuse any request made regarding manufacturing conditions.

A number of large mills making cotton and linen goods are situated at Augsburg. The wages paid to the overseers and weavers range from $1 to $2.25 per day, while the unskilled workmen receive 75 cents.

The speed of the machines varies according to the grade of goods manufactured, but ranges from 120 to 450 movements per minute. One man takes charge of 15 machines making ordinary plain goods, while in some high-grade goods 2 to 4 machines are operated by 1 person. The cost of living is from $190 to $476 a year, according to the size of family. There are small houses for two families and also tenement houses, the rent for 3 rooms and a kitchen amounting to from $30 to $50 per annum.

PLAUEN.

CONDITIONS AMONG THE FACTORY WORKERS IN SAXONY.

Consul Carl Bailey Hurst, of Plauen, presents the following review of the textile industry in that part of Germany, and describes conditions among the factory operatives:

The manufacture of machine-made laces by means of embroidery comprises the chief industry of Plauen, to the exclusion of woven cloths, which are produced in other parts of this district, principally in the towns of Greiz and Reichenbach. It is to these places that one must look for information as to the textile industry in this section of Saxony.

The wages paid to those employed in the weaving mills vary considerably. The scale of even two years ago is not applicable now. The tendency is toward a general increase, but the periods of activity and depression, the disturbances caused by small demand, strikes, and higher cost of raw materials must be frequently taken into account in giving the average rate of wages.

LESSENED PROFITS DUE TO MARKET UNCERTAINTIES.

The manufacturers, in their endeavors to make a fair profit, are constantly harassed by the uncertainties of the market, and such factors tend to have a lowering effect on wages; but once the wages are raised it is difficult to reduce them again, no matter how urgent the reason. There are complaints from both sides. The manufacturers are working at less profit than ever before, and the operatives are looking to a further increase in pay. Some older houses, after having taken in the sons of the members of the firm, find that the profits have become so

divided that there is no longer a competence for most of them. The situation has reached such a condition that some firms in this locality are dissolving old existing partnerships, as the business is not sufficiently remunerative for all partners. It is the intention, however, of most of such members to continue on their individual accounts.

Notwithstanding this narrowing in the margin of profits in the local textile industry, the demands of the operatives are not without foundation. It is not that there is so much money made in weaving here, but rather that the cost of living has increased in such marked degree that the wages of a few years ago do not suffice to-day. It is the clamor, not for the comforts of life, but for the bare necessities, that makes mill hands seek for higher pay.

WAGES OF OPERATIVES.

Women and girls are employed very largely in the factories. The average wages paid to overseers range from 24 to 40 marks ($5.71 to $9.52) a week, only in rare instances higher than this. The wages paid to operatives, on an average, are nearly 16 marks ($3.81) a week. This latter rate was established the beginning of last year, when the average weekly payment was 13.99 marks ($3.33). The employers say that a number of the workmen do not earn the pay they receive in relation to the work done. Operatives are striving to have a minimum of 18 marks ($4.28) a week established. This is being strongly opposed by most manufacturers. Before the latest increase in wages was granted, the operatives, both sexes, divided into four classes, earned as follows:

Class of weavers.	Wages per week.	
	Marks.	*Dollars.*
Up to 16 years of age	10.38	2.47
From 16 to 21 years	12.96	3.08
From 22 to 55 years	16.08	3.83
Over 55 years of age	13.38	3.18

There are, of course, exceptions in different places, and one finds wages in some cases as high as 18 marks ($4.28) per week being paid, which counterbalance some wages as low as 7 marks ($1.67) a week.

STRINGENT LAWS REGULATING HOURS OF LABOR.

There are very stringent laws for the observance of hours of labor for operatives, and as far as the regulations are not promulgated through the imperial federal council they may be fixed through the central authorities of a German State or through police regulations applicable to this district. Before the issuance of such regulations opportunity must be given the chairman of the interested trade guild to express an opinion on the subject. By decision of the federal council, regulations can be laid down for industries in which, through excessive duration of daily working hours, the health of the employees is threatened; also, the length, beginning, and closing for the permissible daily period of work and the intervals of rest to be allowed.

It is required that regulations as to working hours, as well as the rests for adult operatives, shall be conspicuously posted. When by reason of accident the regular work of a mill is interrupted the daily period of work may be extended later by the imperial chancellor.

In urgent cases the local authorities can permit such exceptions, yet in no instance for over fourteen days. This is besides the permission, also obtainable through the local authorities, to mill owners during seasons when there is an unusual accumulation of work to have their operatives work overtime, not, however, on more than forty days within one year.

The exact hours vary considerably, according to the mills. Some begin in summer at 7 in the morning and close at 7 at night, and in winter the hours extend from 7.30 a. m. to 7.30 p. m.; others, for adult workers, from 6 a. m. to 7 p. m. in summer, and in winter from 7 a. m. to 8 p. m. For children from 14 to 16 years, from 6 a. m. to 6 p. m. in summer, and from 7 a. m. to 7 p. m. in winter. Rests are allowed for adult workers as follows: From 9 to 9.15 a. m., from noon to 1.30 p. m., and from 4 to 4.15 p. m. For operatives from 14 to 16 years of age, from 9 to 9.30 a. m., from noon to 1.30 p. m., and from 4 to 4.30 p. m. In some smaller places the rests are arranged in summer from 8.30 to 9 a. m., from noon to 1 p. m., and from 4 to 4.30 p. m.; in winter from 9 to 9.30 a. m., from noon to 1 p. m., and from 4 to 4.30 p. m.

FEMALE AND YOUTHFUL EMPLOYEES.

According to the law, mills must permit female operatives over 16 years of age who have a household to care for to leave, at their own request, a half-hour before the midday interval, provided that there is not allowed at least an hour and a half as the regular dinner hour. During the recesses the machines will be stopped. Young operatives are not allowed to remain in the working rooms. They have to retire to a specially assigned room, if they do not go outdoors. The bringing of food and drink is only permitted during the prescribed periods of rest. Female operatives must not be kept at work after 5.30 p. m. on Saturdays or on the day before holidays. For adult female operatives the afternoon recess on such days is to be omitted.

Female operatives may not be employed in the mills from 8.30 p. m. to 5.30 a. m., and on Saturdays and the days preceding holidays not after 5.30 p. m. The employment of female operatives over 16 years of age must not exceed a total of eleven hours daily, and on Saturdays and the days before holidays may not exceed ten hours.

Children under 13 years of age must not be employed at all in mills; children over 13 years old may only be employed, if they are not obliged longer to attend public school. The employment of children under 14 years must not exceed six hours daily. Young people between 14 and 16 years of age must not be kept at work in the factories more than ten hours a day. The work hours of young operatives must not begin before 5.30 a. m. and must not continue later than 8.30 p. m. Young operatives who work only six hours a day must have a rest of at least a half hour. Other youthful operatives must have at least one hour at noon and a half-hour each in the morning and afternoon. A morning and afternoon rest need not be granted, provided that the young operatives are not at work over eight hours altogether, and the duration of one uninterrupted period labor does not exceed four hours. On Sundays and holidays operatives must not be employed at all or at those hours which

their clergymen have set apart for the religious instruction of such operatives.

Operatives under 17 years of age, who are obliged to attend compulsory school courses at certain times during the week, will receive the necessary liberty, but they must state their school hours in advance at the office of the mill.

INSPECTION OF MILLS—MACHINERY AND PRODUCTS.

It is probably known to American textile manufacturers that the weaving mills in this district are practically closed to expert inspection except to the Government. While showing every courtesy to inquirers, a divulgence of information which may or may not be secret is in many instances withheld, and when imparted it is with the understanding that any data supplied will be in no way made public. This policy is followed to avoid giving any possible aid to competitors.

The peculiar finish given the woolen dress goods of Reichenbach and Greiz has enabled them to be sold in the United States, in spite of the fact that the original value on the German market is often considerably more than doubled by the time they reach the wholesalers in New York.

The machinery employed in making lady's cloth and similar textiles often varies, because manufacturers have had certain alterations or improvements added that are not found in other mills of the same locality. All looms used for weaving woolen cloths are of German origin, and in most instances are made by a Chemnitz firm or by a firm at Furth, near Chemnitz, and cost about 800 marks ($190.40) each. The latter firm also furnishes a machine for dressing the warp for 4,000 to 5,000 marks ($952 to $1,119). French machines are occasionally used for the same work, and cost from 8,000 to 9,000 marks ($1,904 to $2,142). They take up less space and do double the work of the usual machine, but when a yarn breaks the machine must be stopped until the damage is repaired. The consequent loss is accordingly greater.

New weaving looms made in Plauen are to be put on the market before long and will possess important improvements that bid fair to make them a valuable innovation. One of the simpler looms now in use making Reichenbach cloth is generally operated by one man. A single loom finishes, under the most favorable circumstances, a piece of 50 meters (54.68 yards) in length, from 90 to 130 centimeters (35.43 to 51.18 inches) wide, during the ten and one-half working hours of a day. Four times 50 meters of Jacquard stuffs may be made in a week.

Forty-four samples of henriettas, voiles, broadcloths, cashmeres, serges, and fancy stuffs made in this district are submitted herewith [on file in the Bureau of Manufactures], giving the weight per square meter, kind of yarn used for weft and for warp, price of weft and of warp per kilo, cost of weaving per 100 meters, and relevant items.

EFFORTS OF OPERATIVES TO BENEFIT TH

The rise all over Germany in the cost of li
siderable attention during the past two or t
of meat *went to a figure* never reached bef

has been a slight decline they will probably never descend to their former level. Manufacturers here have, of their own initiative, and also by reason of formal demands and strikes of the operatives, advanced the wages of weavers in general, but the increase has not kept pace with the higher cost of living, and the result tells heavily on the mill employees. The Government has bureaus to facilitate the employment of those out of work and there are private societies to improve the condition of the working people.

The operatives are themselves banding more together, aiming at a solidarity, which will be at the same time of political influence, to the end that measures may be enacted of benefit to them in getting higher wages, shortening the work hours, and obtaining other advantages. The operators hope to compel mill owners to accord them a fixed minimum rate of wages in excess of what they now receive. Through their own journals, labor unions, and labor leaders they maintain an unceasingly active campaign that will enable them to meet the higher cost of living.

Herewith I submit a form [on file in the Bureau of Manufactures] that is filled out by those joining the Union of German Textile Workers, the headquarters of which is in Berlin. On this form the name of the operative has to be given, the date and place of birth, residence, firm by which he or she is employed, the department in the mill and the machine number, whether married, and how many children under 14 years of age. It must be also stated on the form how many hours the operative works a day and what the average earnings are per week. Membership is divided into four classes, paying 20 pfennigs ($0.0476), 30 pfennigs ($0.0741), 40 pfennigs ($0.0952), and 50 pfennigs ($0.119), respectively, a week. The admission fee is 30 pfennigs ($0.0714). The first class is only for male and female workers under 18 years of age. The other three classes may be entered by all operatives without regard to age or sex. The relief funds are eventually distributed according to the class and the number of weekly dues paid. While seemingly light, these fees are in many instances not paid without sacrifice on the part of the operatives. In further connection with the cost of living, the obligatory contributions to the State old-age and accident insurance, as well as to the sick funds, must also be counted.

ECONOMY IN LIVING—FOOD OF THE WEAVERS.

The families of the working people are rarely small, and it is not infrequent to find a man and his wife and several children subsisting on $3.81 a week. From this amount rent, clothing, food, fuel, and other necessaries have to be paid. In many instances, however, the wife is also a wage-earner as well as the man, and the children go to work as soon as possible. Such families usually live in a kitchen and one other room. There the family cooks, eats, and sleeps. The rent for such an apartment is rarely less than 10 marks ($2.38) a month, the general price being about 15 marks ($3.57). Some of the operatives are better placed and have their own small dwelling in the suburbs with garden attached. It may be remarked that on Sundays or holidays, when enjoying an outing, the operatives always appear well and comfortably dressed. A ragged or barefooted person is a most unusual sight.

Food is of necessity quite simple. One person thoroughly acquainted with the life and conditions of operatives here says that the principal nourishment of the weavers consists of potatoes and salt, bread, and a so-called pepper soup, made of water, bread, a little fat, and plenty of pepper. Meat is seldom eaten, and when indulged in at all is usually in a form of soup meat or sausage. Operatives generally eat five times a day, and rye bread is nearly always taken. The first breakfast consists of coffee, made chiefly of roasted grain, and a piece of bread or roll. Sometimes a bowl of hot water with a little flour stirred in is taken instead of coffee. The dinner is at midday. The morning, afternoon, and evening meals are much lighter, and in them beer often occupies a place.

That operatives can manage to live on this small income is evidenced by the thousands of persons working from one year's end to another in the textile mills. They are exerting themselves to better their condition and they have sympathizers here in all classes of society, not excluding many mill owners.

STUTTGART.

WOOLEN YARN MILLS—STATUS OF OPERATIVES.

Consul Edward Higgins makes the following report from Stuttgart on the spinning of woolen yarn in that German district:

There is no export to the United States of woolen cloth or yarns from this district, which comprises the kingdom of Wurttemberg and the principality of Hohenzollern. There is no manufacturer of woolen goods in the district and only a few factories making woolen yarns. The facts contained in this report come from the largest firm in the district, employing about 500 hands. The wages paid overseers vary from 120 to 200 marks ($28.56 to $47.60) per month. A female operative earns from 2 to 2.8 marks (47½ to 66½ cents) per day and a male operative from 3 to 4.3 marks (71 cents to $1.02) per day. Eleven hours a day constitute the regular hours of labor for six days in the week. Some English machinery is used, but the great bulk is German. The machinery is run at a speed of 3,000 to 3,500 turns per minute for knitting yarns, to 5,000 turns per minute for weaving yarns. The production is knitting yarns and fancy colored yarns for weaving purposes.

In the preparatory department one operative generally tends two machines, while in the spinning department the rule is one machine to one operative. The output of these mills is largely sold to woolen weavers in Germany, Austria, and Switzerland.

COST OF LIVING AND HOMES OF THE WORKERS.

The Wurttemberg factories are located in small country villages, where a tenement of three rooms and kitchen can be had for 180 to 200 marks a year ($43 to $47). The operatives live largely on potatoes and bread, with very little meat. Some factories furnish dinner to their operatives, consisting of meat, vegetables, and bread, at 25 pfennigs (6 cents), in a dining hall connected with the factory.

In many places the houses occupied by the overseers and mill workers in the textile industry of Wurttemberg are built by the proprietor of the mill. An insurance company of Wurttemberg advances 50 per

cent of the cost of building and as security this insurance company receives the first mortgage on the houses. This company charges 3 per cent interest. The owner of the mill generally takes the second mortgage and advances the other 50 per cent of the cost of building. He also charges a low rate of interest. The workingman occupying one of these houses must pay the interest on the first and second mortgages and a small stipulated sum (about $25) every year on the mortgages. It takes about thirty years for the mill operator to get a clear title to the dwelling. A small garden is connected with each house.

ZITTAU.

OUTPUT OF VARIOUS SPECIALTIES FROM AMERICAN FIBER.

Consul Clarence Slocum, of Zittau, furnishes the following report on the manufacture of cotton goods in his consular district:

The ever increasing use in Germany, as in all other countries, of articles made of cotton has contributed greatly to the general prosperity of this district, in which are located some of the oldest cotton mills in the Empire, their establishment dating from 1666. While in Zittau proper only a small percentage of the manufactures can be classed under this heading, four large adjacent villages—Neugersdorf, Ebersbach, Seifhennersdorf, and Grosschönau—with a total population of nearly 40,000 people, are famed each for its special line of cotton manufacture and possess some of the largest mills in the German cotton trade.

It is interesting to note that the bulk of the goods woven in this district are made from American cotton, the yarns used ranging from 8s (8 hanks to the pound) to 50s count, single and double, while 16s to 26s comprise the range of counts of the bulk of the material used. As there are comparatively few spinning and doubling plants in this district, the yarns are principally supplied by spinners in southern Saxony, Bavaria and Rhenish Prussia.

AMERICAN COTTON CONSUMED.

No statistics are published as to the number of bales of cotton used by local manufacturers, but from figures obtained I estimate the consumption of raw American cotton at from 60,000 to 70,000 bales. This quantity of material is used to supply, approximately, 16,000 looms, which furnish employment for some 25,000 work people in addition to those engaged in the allied trades of dyeing, finishing, sizing, etc. The goods principally manufactured comprise plain and fancy dress goods, vestings, coatings, trouserings, sheetings, Turkish towelling, flannelette, blankets, rugs, and colored fancy table covers.

A conservative authority informs me that the domestic consumption of the local cotton productions equals fully three-fourths of the district's output, while the balance is exported to all parts of the world, in part through connections of the various manufacturers and also through the active agency of various Hamburg houses.

In so far as this district's trade relations with the United States are concerned, articles made of cotton rank second to linens in point of volume of business accomplished, the total shipments for the fiscal year 1907 having reached the sum of $225,019, out of a total declared export return of $1,625,474.

AUSTRIA

COTTON MILLS AND EQUIPMENT.

COTTON MANUFACTURING THE LEADING INDUSTRY—IMPROVEMENTS IN MILLS AND MACHINERY.

During 1906 and 1907 Austria enjoyed an unusual measure of prosperity, and this was especially felt by the cotton industry. A series of five years of exceptionally good crops have increased the absorptive power of the people to a degree that more than compensated for the decline of their exports to one of their principal markets caused by the customs war with Servia. The quality of the production has been raised and the mills now produce yarns and cloth that were formerly exclusively imported. The imports of cotton manufactures do not as yet show any decrease in quantity, but the home mills have filled a large part of the enlarged home demand that would otherwise have been secured by foreign mills, and in addition the Bohemian mills have shipped good quantities of yarn over the border to supply the needs of Saxon weavers.

The Austrian spinners have not felt the present financial disturbances of the world as much as have the weavers, for they are engaged longer ahead, in many instances for the whole of 1908, while the weavers have future orders for only a few months. The effects of the present financial situation is seen in the sudden holding up of the mill-building boom that has been in full swing in Austria for the last two years. It is estimated that during 1906 there were 400,000 spindles and during 1907 some 600,000 spindles, added in this industry alone, but these are estimates, and there are no definite figures available. The increase, however, has been such as to make cotton manufacturing the leading industry of Austria.

LOCATION OF THE MILLS.

The cotton mills in Austria divide themselves into four separate groups: The Bohemian mills along the northern border, the lower Austrian mills lying just south of Vienna, the Vorarlberg mills, and the mills around Trieste.

The first section, the Bohemian mills, is by far the most important, and Bohemia now contains about 60 per cent of the mills of the country. These mills lie along the northern border and are geographically and commercially close to the Saxon and Silesian mills just over the line. Some Saxon mills depend for their yarn on the Bohemian spinner and when, as in 1906, the German weavers have

an unusually flush period this business increases largely. The center of the Bohemian cotton industry is Reichenberg, which is therefore practically the center of the industry in Austria. Within a short distance from this place are many cotton-manufacturing towns, including such places as Grottau, Ketten, Kratzau, Machendorf, Turnau, Halbstadt, Eisenbrod, Josepstadt, Tannwald, Morchenstern, etc., all of which are steadily growing in importance as cotton-mill centers.

RIVALRY BETWEEN CZECHS AND GERMANS.

The Bohemian cotton industry was started and is now owned by German-speaking people of German descent. The Czech-speaking people, however, have begun to start an industry of their own, and have built up quite a group of mill towns which center around Nachod, not far to the eastward of Reichenberg. Of some 6,318,000 people contained in Bohemia, about two-thirds are of the Czechish-Slavonic race, and the others are mainly of Teutonic descent. These latter are scattered but occupy mainly the western and northern portions, while the Czechs are strongest in the central and eastern portions. There is great rivalry between the two races and this rivalry at present is having its effect in stimulating each to get ahead of the other in extent of business and has led to many new mills. The Bohemian industry in general has the advantage of proximity to coal fields, of a better class of help, and of being in closer touch with the great manufacturing nation over the border.

The second section of mills are grouped just south of Vienna and especially around Pottendorf. This section of lower Austria is one of the oldest cotton-manufacturing localities in Austria, and before the time of railroads or of modern mill machinery was quite a hand-loom center, and cotton from Adana, Smyrna, Greece, etc., was brought in at Trieste and then carted a long distance and through some steep mountain passes over to the lowlands of this section. These mills are nearest to the export commission houses which are mainly centered at Vienna, and enjoy favorable banking advantages, but their class of help does not seem to be quite as good as that of Bohemia, and recently with the increase in mills and the drafts made on them for operatives by Hungarian mills there has been a scarcity of labor.

The third group of mills lie in the Vorarlberg, which is the extreme western section of Austria that juts up into the Swiss highlands. The mills in this section are largely dependent on the embroidery trade for the consumption of their yarns and cloths, and their profits rise or fall with the prosperity of this branch of industry. They ship some goods to the Swiss embroidery factories lying around St. Gall, but otherwise they do little export business.

The fourth and smallest section of the Austrian cotton-manufacturing industry lies in Kustenland and Krain around Trieste. These mills use a larger proportion of East Indian cotton than the other mills. They are more favorably situated for export, but the labor difficulty is greater in regard to quality as well as quantity of help, the mills are more isolated, and they are farther from the machinery makers, from the bleacheries and dyehouses, from the financial centers, etc., so that the industry is not building up much at this point.

SPINDLES AND LOOMS.

In regard to the actual number of spindles and looms in Austria there are no Government or authoritative figures available. The latest figures that the Austrian Cotton Spinners' Association was able to give were those for January 1, 1907. These figures are as follows:

Districts.	Spindles.	Districts.	Spindles.
Bohemia	2,179,091	Styria	42,472
Vorarlberg and Tyrol	414,604		
Lower Austria	388,140	Total	3,512,122
Moravia and Silesia	207,429	Hungary	139,682
Upper Austria	149,820		
Krain and Istria	130,566	Grand total	3,651,804

These figures are only valuable as an indication. In Hungary, for instance, the total of spindles in operation and erection is now (February, 1908) somewhere between 180,000 and 200,000, and, assuming that the total increase in the Kingdom during 1907 reached the figures usually estimated, the number of spindles in Austria alone is now something over 4,000,000.

The majority of the mills in Austria are small, but the tendency is for companies owning several small plants to gradually build up the best-located one and drop the others. The mills are increasing in size from this cause, and also because most of the new mills are of larger size than heretofore usual.

AUSTRIAN MILLS WITH OVER FIFTY THOUSAND SPINDLES.

The cotton-manufacturing companies in Austria operating over 50,000 spindles each are as follows:

Company.	Spindles.	Town.	Section.
Johann Liebig & Co	131,856	Eisenbrod	Bohemia.
Johann Erben Priebsch	131,732	Morchenstern	Do.
Herm. Pollak's Söhne	100,352	Braunau	Do.
Friedrich Kubinsky	85,000	Beraun	Do.
Jenny & Schindler	84,432	Bregenz	Vorarlberg.
Friedrich Schmidt	72,500	Iserthal	Bohemia.
A. G. der Baumwolle Spinnerei Trumau und Marienthal.	70,708	Trumau	Lower Austria.
Benedikt Schroll's Sohn	70,000	Halbstadt	Bohemia.
J. B. Limburger, jr	67,000	Ketten	Do.
K. k. priv. Pottenderfer Baumwoll-Spinnerei und Zwirnerei.	65,000	Pottendorf	Lower Austria.
Getzner, Mutter & Co	64,152	do	Do.
Franz Priedl	62,882	Bohm-Kamnitz	Bohemia.
Herrburger & Rhomberg	58,272	Dornbirn	Vorarlberg
A. G. der Kleinmunchner Baumwoll-Spinnerei und Mech. Weberei.	57,784	Linz	Upper Austria.
Johann Munzberg & Co	56,454	Theresienau	Bohemia.
Johann Gottfried Haebler	56,000	Warnsdorf	Do.
Gebruder Grohmann	56,000	Bensen	Do.
Mako-Spinnerei Cichorius & Co	54,332	Kratzau	Do.
Friedrich Mattausch & Son	54,136	Franzenthal	Do.
F. M. Hammerle	51,336	Dornbirn	Voralberg.
S. Kratzau	51,300	Nachod	Bohemia.
Cosmanos Vereingte Textil- und Druckfabriken	50,000	Grottau	Do.

The largest weaving mill is the Aktien-Gesellschaft Osterreichische Textilwerke, formerly Isaac Mautner & Sohn, which has 2,397 looms at Grunwald, near Gablonz in Bohemia.

The largest Austrian cotton manufacturing company is seen from the above list to be that of Johann Liebig & Co. The beginning of

this company was in 1806, when Count Christian Clam-Gallas, in company with a certain Francke, of Reichenberg, established a cotton-spinning mill, which began work on October 7 of that year under the registered firm name of Clam-Gallas, Francke & Co. This factory was sold in 1808 to Balabene & Co., and by them in 1828 to Gebruder Liebig. This firm, since changed to Johann Liebig & Co., enlarged the factory as their business increased, and, besides at Reichenberg, now have mills at Eisenbrod, Haratitz, Swarow, and Mezivod, with a total of 131,856 spindles and some 2,400 looms, and employ 4,500 workers.

MACHINERY ADVANCES IN PRICE.

The prices paid for cotton-mill machinery by Austrian mill men are much higher now than they were two years ago. This is due to the effect on the textile-machinery trade of the great mill-building boom in England. This has so absorbed the production of the English textile-machinery firms that not only have they raised the price 25 per cent more, but they will not quote on orders except for very late delivery, in some cases twelve to eighteen months' time. This situation has been of great benefit to the Austrian textile-machinery manufacturers, and they have taken advantage of the same and a good many new firms have started in this business. They have not yet the perfection of the English, nor do they manufacture in as large quantities, and the English in normal times can still control the Austrian market on this line. In regard to present prices there is quite a fluctuating market, and no prices could be quoted that would apply to all.

At Prague a large manufacturer, who has recently purchased machinery, gave me the prices he paid in the latter part of 1907. The cards cost in England £100 each, and, adding 10 per cent for packing and then the transportation and duty charges, the cost landed at Prague was about 3,000 kronen, or, say, $609. The ring spinning frames cost 8s. 6d. a spindle in England, and the price landed at Prague came to 6,000 kronen per 450-spindle machine, which is about $1,218.

At Reichenberg the February, 1908, prices were given by the mill men as follows:

Description.	Kronen.	Dollars.
Bale breaker	1,300.00	264.00
Ten-meter dust trunk, with hopper feeder	1,400.00	284.00
Exhaust opener, with one beater and lap apparatus	1,180.00	240.00
Single Crighton opener	2,600.00	528.00
Double Crighton opener	3,400.00	690.00
Lapper	3,300.00	670.00
Revolving flat card, with appurtenances	3,100.00	630.00
Draw frame with 3 by 6 deliveries	4,200.00	853.00
Draw frame with 3 by 7 deliveries	5,200.00	1,056.00
In general per draw-frame delivery	240.00	49.00
Slubber of 84 spindles	4,300.00	873.00
In general per slubber spindle	52.00	10.50
Intermediate of 128 spindles	5,000.00	1,015.00
In general per intermediate spindle	40.00	8.12
Fine frame of 168 spindles	5,200.00	1,056.00
In general per fine-frame spindle	32.00	6.50
Self-actor mule for warp per spindle	8.80	1.19
Self-actor mule for filling per spindle	8.20	1.67
Ring spinning frame per spindle	12.40	2.52
Looms for gray goods 110 centimeters wide	350.00	71.00

The great bulk of the Austrian cotton mills are owned by private parties, and "Aktien-Gesellschaft," meaning stock company, is seen before the names of few mills. One reason of this is that taxes are cheaper for a private mill than for a stock company, and another is the fact that private companies who have no shares to list on the exchanges do not have to publish their statements in the papers, as do stock companies. Owing to the increase in mills in the last two years, and the interest that is taken in cotton manufacturing by the general public, there are now an increasing number of stock companies listed and some private mills have changed to stock companies.

SPINDLES—SPEED OF MACHINERY—COAL.

The majority of the spindles in Austria are mule. There are no statistics on this point, but large manufacturers estimate the mule spindles as double the number of ring spindles. The bulk of the spinning machinery is of English make, while the majority of the weaving and finishing machinery is Austrian and German. Machinery from all the large English concerns is seen more or less. One of the most popular Austrian textile machinery firms is that of G. Josephys Erben, at Bielitz, but there are other textile machinery firms at Reichenberg, Jagersdorf, and other Bohemian and Silesian centers, as well as some at Vienna. The number of Austrian textile machinery manufacturers is increasing, and they are making more efforts to control their home markets. German machinery is mainly imported from Chemnitz, and some from Mulhausen. They are beginning to get quite a foothold in spinning machinery, which is a line that England has heretofore monopolized.

In regard to speed of machinery, there is nothing to be said of value. The mills base their speeds on the English catalogues and production tables and run as near the speeds given as the quality of their help and material will permit. For instance, on a good quality of Cabots I found that the Austrian weavers run their looms at the ordinary 180 picks to the minute, but some claimed to run 200 or over, and others using lower-grade materials could not get over 160. About one-third of the 650,000 bales of cotton imported into Austria comes from India, and where this is mixed with American, or where low-grade American cotton is employed, the speed is necessarily curtailed.

The Bohemian mills are situated in proximity to coal fields, and they have cheap fuel, but the quality is low. Ordinarily the Bohemian coal fields supply the home demand, but in 1907 the consumption overtook the production and coal had to be imported, and prices ran somewhat higher than usual.

INCREASE IN STRIKES AND LOCKOUTS.

There has been a great increase in industrial, especially textile, strikes and lockouts in the last two years. This may be explained partly by the better industrial conditions which make the need for labor more apparent, the workmen taking advantage of this situation to better their condition, and partly by the increased cost of living. Unions are increasing in number and activity and many strikes now involve a whole branch of industry instead of being en-

tirely localized as formerly. These strikes have caused similar organization of employers, and in many cases such movements are now answered by lockouts at their inception. In general, strikes are for higher wages and shorter hours, but also a good many are for other objects, such as increased compensation for overtime and Sunday work, for early closing on Saturdays and before holidays, for recognition of the union and of walking delegates, etc. In the majority of cases the workmen have won as regards wages and hours. The demands for the recognition of the union also do not meet with as general a refusal as formerly, and this is shown by the frequent intervention of laborers' organizations in wage agreements. In some cases part of the wages were given in beer tickets instead of cash, and some mills made it obligatory for the operatives to take board and rent of their employers. Strikes to remedy these conditions were also successful.

The longest strike in textile circles was in the latter part of 1906 at Reichenberg, and lasted over eighteen weeks. It resulted in the recognition of the union; in granting "Laborers' Day," May 1, as a holiday; in a compensation of 90 heller per loom when bad material is furnished; an increase of wages in various kinds of labor; tariff to be published on the wall; married women to be entitled to leave at 11.30; lunch to be brought to the mill by special hands; compensation of narrow goods on wide looms to be according to a special tariff; no new laborers to be accepted for a certain period after the strike, etc.; while the strikers obliged themselves not to interfere with those who remained at work and did not strike. The Government intervened in a good many of the strikes and lockouts.

In the smaller mills the working conditions as to light, cleanliness, etc., are not as good as they might be, but in the majority of the mills, especially the large ones, they are very good.

WAGES AND LABOR CONDITIONS.

EARNINGS OF OPERATIVES IN THE COTTON MILLS—PROVISIONS OF THE INSURANCE AND PENSION FUNDS.

In regard to wages paid in Austrian mills there is great variation between the different sections and between the town and the country mills in the same section. As a rule it seems that the mills nearest Vienna have to pay the highest wages, followed by the central Bohemian mills, while mills in the more sparsely settled sections of eastern Bohemia and lower Austria get their help cheapest. Nachod, for instance, pays much smaller wages than Tannwald or Reichenberg, but living is cheaper at Nachod. From wage lists obtained at various mills it would seem that 50 cents per day might be taken as the average cotton-mill wage throughout Austria.

On account of heavy taxes most of the Austrian cotton mills are private companies. The system of management is a little different from the ordinary American custom of a superintendent, boss carder, boss spinner, and boss weaver. The superintendent is here called the technical director or manager, and under him there is an assistant manager. There are no heads of the different rooms, but instead a foreman for each group of machines. Thus, in the "Prag-Hollescho-witzer Baumwollspinnereien Leopold Mahler," at Prague, a yarn mill which operates 26,012 spindles on yarn, 900 waste spindles, and 3,048 twister spindles, there is a technical director, with one assistant for day and one for night work. Under the assistant there are the following foremen or second hands: Blow room, 1; cards, 1; fly frames, 3; ring spinning, 4; mule spinning, 4; doublers, 1; winders, 1; yarn-delivery room, 1.

WAGES IN BOHEMIAN MILLS AND WORK PERFORMED.

As a fair example of an average mill, in respect to management and wages, I give the following detailed list of a 40,000-spindle, 900-loom Bohemian mill near Reichenberg:

Picker room—per day, men, 48.7 cents; women, 34.5 cents.

Cards—1 card grinder to every 20 cards, $4.06 a week; 1 can girl, 34.5 cents a day; 1 lapman, 48.7 cents to every 12 yards; 1 cleaner, 48.7 cents a day for every 24 cards.

Draw frames—7 deliveries; paid 1.32 cents a hank for No. .13 hank sliver.

Slubbers—pay, 4.47 cents a hank for No. .50 hank roving, and 5.48 cents a hank for No. .60 hank roving; the operative makes $3.25 to $4.46 a week.

Intermediates.—Pay, 5.08 cents for 1.2 hank roving and 5.88 cents for 1.5 hank roving; make $2.84 to $3.85 a week.

Fine frames.—Tenders, 4.87, 5.08, 5.28, 5.68, 5.88, and 6.09 cents per hank for Nos. 2, 2½, 3, 3½, 4, and 4½ hank roving. The fine frame tenders make $2.48 to $5.28 a week; they usually run 1 frame, but some run 2, and these make the higher wage. On the 40-fly frames at this mill there are employed 15 helpers to lay up roving, help doff, etc., at 30 cents a day.

Ring spinning.—Each girl runs 1 frame of 450 spindles and does her own doffing. The girls of every 4 frames are supposed to work together when doffing. These spinners are paid per hank as follows: Nos. 10 to 22s, 3.41 cents; Nos. 24 to 28s, 3.65 cents; Nos. 30 to 36s, 3.84 cents; No. 40s, 4 cents; No. 44s, 4.12 cents; No. 46s, 4.30 cents,

Mule spinning.—The mules at this mill are of 568 spindles each, and 1 spinner, 1 apprentice spinner, and 1 creeler run 2 mules (1,136 spindles). They are paid per 1,000 stretches, of 66 inches per stretch, as follows:

Pincops.	Spinner.	Apprentice spinner.	Creeler.
	Cents.	*Cents.*	*Cents.*
Nos. 6 to 9	13.86	12.67	8.42
Nos. 10 to 11	12.67	11.49	7.92
Nos. 12 to 14	12.18	10.98	7.65
Nos. 15 to 22	11.69	10.47	7.41
Nos. 23 to 30	11.94	10.72	7.13
Nos. 31 to 42	12.77	11.49	6.90
Nos. 44 to 46	12.93	11.65	6.90
No. 50	13.28	12.02	6.90

EARNINGS OF THE VARIOUS OPERATIVES.

If one figures on a production, as they do here, of 5.84 hanks of No. 20s per ten hours, the spinner's wage is found to be 63 cents a day. Reelers are paid by the kilo (2.2 pounds); warpers run 1 machine each and are paid by the 100 kilos (220.46 pounds) or 1,000 meters (1,090 pounds); spoolers are paid by the day and winders by the kilo. The rate of pay is so arranged that all of these earn from 41 to 49 cents a day.

The foregoing are the actual wages paid at one Bohemian mill and except for the mule spinning wages, which are low, may be taken as a good average, though, of course, there is much variation. Draw-frame tenders, fly-frame tenders, and ring spinners are, in nearly all Austrian mills, paid by the hank. On the mules, however, it is more customary to fix a set price for the spinner per day, based on the required production, the ordinary requirement being 35 hanks of No. 20s per week, and then to pay the piecers 70 per cent of the spinners' wages, and the creelers 50 per cent. The usual mules are 900 to 1,000 spindles each, and for 2 mules, 1,800 to 2,000 spindles. Most mills require 1 spinner at $1.02, 2 piecers at 71 cents, and 2 creelers at 51 cents; this for No. 20s.

Weavers are paid sometimes by length, but oftener now by the 1,000 picks. At the foregoing mill the following are the weavers'

wages per 100 meters (109 yards) of the main varieties of cloth produced (gray cloth):

Cloth.	Width in inches.	Threads per quarter inch.	Yarn Nos.	Wages.
Plain goods	34.2	21/21	36/30	$0.75
Twills	49.6	26/13	24/11	.87
Satin	34.2	25/16	20/16	.65
Damask	34.2	24/20	36/50	1.46
Batiste	31.5	21/19	60/80	.73
Plain goods	37.4	13/13	20/22	.47

Weavers, as a rule, run 2 to 3 looms and make 61 to 81 cents a day. The majority of the looms are of English or Austrian make and of the overpick style. There are, however, quite a number of mills that use the underpick loom only, where the managers prefer them for plain goods as making better cloth. There are some Northrop looms, but they are not widely used. Several mills use the battery made at Chemnitz in preference to the Northrop. In this battery pincops can be used by being slid on a special spindle with iron base, and as most of the weavers buy only pincops this is quite a convenience. A large number of looms in Bohemia are on calico, using 36s and 42s yarn.

WAGES IN POTTSDORF AND PRAGUE MILLS AND WORK PERFORMED.

At Pottsdorf, near Vienna, in a large mill having 52,000 mule spindles and 8,000 ring spindles, I found that on No. 44s there were required, per 2 mules of 2,536 spindles, 2 spinners at $1.02, 1 piecer at 61 cents, and 1 boy creeker at 41 cents per day. At this mill the ring frames were 516 spindles each and each girl ran 1 frame, did her own doffing, and made the usual 41 cents a day. The manager of this mill said that they formerly used doffers, but that there had been of late years a scarcity of help, especially of girls, so that he had to dispense with separate doffers, even though thereby the production was slightly decreased.

At this mill there were 105 cards, and 1 lapman supplied laps for the lot. There was a line of steel bars suspended from the posts back of each row of cards, and a lap carrier holding 6 laps was suspended from rollers resting on this. The picker room was at the end of the card room, and everything conveniently arranged. One carder at 49 cents and 1 boy at 41 cents per day attended to each 12 cards, and did all the work except grinding. In front of each line of cards was suspended a 6-inch tin pipe line with a hinged cap opening at each card. These pipe lines were attached to a suction fan at the end of the room and were used to convey away all the waste. On the same floor with the cards were the draw frames, slubbers, and intermediates. The different machines were not banked together, but there was a succession of groups of 2 lines of drawing, a slubber, and an intermediate. The fine frames were all on the second floor. On the fine frames 1 woman and 1 girl ran 2 machines of 180 spindles each, and their wages averaged $2.94 each a week.

At a mill near Prague, where I found doffers employed, the spinners ran 1 frame of 450 spindles each, were required to get 38 hanks on No. 20s a week, and for this were paid $2.44 a week for day work and $3.05 for night work. For 22 frames there were 18 helpers or doffers at 32 cents for day and 41 cents for night work.

WAGES IN TYPICAL AUSTRIAN MILLS—FOOD PRICES.

I have made up the following table as showing wages and cost of living for six typical Austrian cotton mills. The table is prepared from unpublished statistics given me by the president of the Austrian Cotton Spinners, as being actual figures recently compiled by a member of his association, and from statistics obtained personally:

Description.	Lower Austria.		Vorarlberg.		Bohemia.	
	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.
OPERATIVES.						
Blow room:						
Head	$0.67	$0.88	$1.02	$0.75	$0.71	$1.02
Operative	.45	.40	.61	.47	.41	.57
Waste man	.45	.32	.73	.45	.45	.53
Cards:						
Head	.94	.88	1.22	.81	.71	1.22
Card grinder	.61	.49	.69	.56	.65	.71
Can men	.49	.35	.54	.46	.41	.56
Lap carrier	.45	.35	.54	.45	.41	.56
Oiler	.45	.....	.42	.45	.41	.49
Draw-frame tender	.50	.38	.42	.45	.41	.49
Fly frames:						
Head	.81	.94	1.36	.81	.71	1.32
Operative	.46	.38	.55	.45	.46	.57
Roving hands	.31	.29	.37	.37	.37	.43
Oiler	.45	.39	.47	.47	.45	.59
Ring spinning:						
Head	.81	.51	1.52	.81	.81	1.32
Spinner	.46	.31	.43	.39	.49	.49
Doffer	.35	.25	.....	.35	.....	.33
Oiler	.45	.....	.53	.45	.41	.41
Mule spinning:						
Head	.94	1.46	1.62	.81	.94	1.42
Spinner	1.09	.67	.80	.81	.61	.79
Piecer-up	.74	.47	.54	.43	.42	.51
Creeler	.47	.24	.31	.30	.31	.32
Oiler	.45	.....	.61	.45	.41	.61
Twisting:						
Operative	.....	.46	.41	.42	.....	.61
Creel hands	.....	.46	.39	.39	.....	.53
Reeling:						
Head	.88	.62	1.12	.81	.....	1.02
Reeler	.37	.62	.47	.36	.....	.57
Packer	.55	.53	.64	.56	.....	.64
Woman bundlers	.63	.53	.46	.37	.37	.53
Machine shop:						
Head	.91	1.62	1.62	1.02	.91	1.02
Machinist	.73	.81	.89	.67	.59	.89
Woodworker	.75	.59	.85	.57	.....	.71
Smith	.....	.61	.73	.....	.....	.61
Engineer or turbine minder	.51	.63	.76	.69	.61	.71
Fireman	.61	.53	.76	.65	.53	.61
Transmission tender	.45	.57	.65	.55	.49	.65
Night watchman	.54	.35	.61	.57	.49	.65
Porter	.54	.....	.53	.55	.41	.53
Average wages	.498	.416	.538	.46	.487	.586
COST OF PROVISIONS.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
Bread (medium quality) per pound	1.9	1.9	2.9	2.8	2.7	2.6
Meat do	14.7	14.0	14.0	15.0	14.3	15.0
Flour do	3.0	3.0	3.5	3.7	3.2	3.2
Potatoes do	.7	.7	.6	.9	.8	.9
Sugar do	7.0	6.3	7.0	7.2	6.6	6.6
Coffee do	26.3	29.5	24.0	28.0	32.0	34.0
Salt do	2.6	2.4	2.2	2.1	2.6	2.6
Cheese one portion	4.1	.....	4.1	3.3	.....	.....
Milk per quart	5.6	3.2	4.2	4.2	5.1	5.3
Oil do	9.3	9.3	9.2	9.2	10.6	11.0
Beer do	5.1	6.0	7.4	7.4	7.0	7.4

The employees live very plainly. Bread, potatoes, coffee, and beer is the standard diet. Meat is high, and only indulged in sparingly on Sundays. The operatives usually have 5 snacks a day, and at Reichenberg the daily cost was figured as follows: Morning meal, at 6—coffee, 10 hellers (2.03 cents), bread, 6 hellers (1.2 cents); lunch,

at 9—bread and butter, 16 hellers (3.25 cents); dinner, at noon—fried sausage and potatoes, 20 hellers (4.1 cents), beer, 9 hellers (1.8 cents); afternoon lunch, at 4—bread and butter, 16 hellers (3.25 cents); supper, at 7—bread, potatoes, and coffee or buttermilk, 25 hellers (5.07 cents); total, 102 hellers (20.7 cents).

Some mills stop a few minutes at 9 and at 4 o'clock for the lunches, but at others the luncheon is consumed during work. Beer is the staple drink in northern Bohemia; wine is not used. In southern Austria wine is more used, and cheese also enters into the diet in preference to sausage.

BENEFITS FOR THE WORKMEN.

In Vienna a wool mill has besides the regular insurance systems, a pension fund for widows and orphans, whereby the widows get 120 kronen a year, and also some free tuition for their children. There are sick benefit institutions at a good many mills. Some mills make up the difference betweeen the sick benefit and the regular wages for one year. In some mills the management pay the workman's family full time while he is away on his six weeks' yearly tour of military duty among the reserves. In some instances when provisions are specially high the mill pays a special extra wage per month of 10 kronen per married couple and 5 kronen to single men. A few mills are introducing participation in profits. Some establishments have arrangements for leave of absence which start with three days and rises to fourteen days a year for full pay. The length of free absence with full pay is proportioned to the number of years employed.

In Bohemia especially the mill managers have made efforts to satisfy their help, partly for business reasons and partly from altruistic motives, but these efforts have not in all cases been well received, and there is more agitation among the workers there than in other parts of the Empire. One manager complained of the fact that the hands would not use baths that the mill had gone to some expense to erect in up-to-date style, and that they tried to nullify every scheme he got up for their benefit. A Government inspector reported a case where an altruistic manufacturer bought a lot of hygienic china spittoons that he hung along the walls of the mills for the use of the hands and that had running-water attachments, etc. These cost him 33 kronen each, but inside of a month in one way or another they all managed to get broken, and the manufacturer concluded that his paternal efforts in the interests of the workingman were of no avail. Some manufacturers consult with the workmen and have more success.

Most mills now have lockers for their help to keep their street clothes in, and some mills furnish working slippers for the women, so that they are protected against risk of sickness from wet shoes. In one case a factory sent three consumptive operatives to a sanatorium at the mill's expense and others to the country for a period of recuperation from sickness. Any reform in methods of work is usually resisted by the operatives, and in cases where mills have introduced such conveniences as knot tyers they had to be diplomatically inaugurated by paying a girl double wages to try the experiment, and then proving to the others the higher wages to be made by getting as much increased production as the inaugurator.

SCARCITY OF SKILLED LABOR—RENTS—OLD AGE PENSIONS.

In making up their report for the year 1906 the Government inspectors said that many of the textile districts in Bohemia needed 30 per cent more hands than they could obtain. This condition of affairs also existed up to the latter part of 1907, when the labor supply caught up with the demand, on account of a slackening up in business due to the effects of the foreign money crisis. There is an increasing demand for skilled labor, which is hard to supply, and the increased cost of living in the last two or three years has of itself forced a material increase in the wages. The cost of living has increased fully in proportion to the increased wages, so that the worker has not benefited materially. This has resulted in the increased establishment of canteens, factory kitchens, and soup establishments. Meat is very high, and there have been efforts to substitute sea fishes. The emigration movement is one factor that has contributed to the dearth of labor, and it may be noted that employment agencies also act as emigration agencies. Just at present this labor scarcity is not so seriously felt, but it will again become a problem demanding attention as soon as business picks up.

The labor problem is also affected by the scarcity of laborers' dwellings, and rents are high in proportion to wages. Because of this fact basements are used as habitations in many towns. The mills have built a good many tenement houses in the last year, especially girls' and bachelors' homes. Workmen's buildings are also being put up by municipalities and by building companies in order to relieve the house famine. Trieste has recently put up some municipal buildings for laborers. One building contains rooms for 32 families, of which 28 consist of one room and the kitchen, and four only of one large room with range, and every flat has its own closet. The rent for the two rooms amounts to 21.5 to 25.5 kronen a month, and for the single room 14.5 kronen a month. The taxes amount to 3 per cent of the rent, and water consumption costs 2 kronen a month. In Prague the Society for Laborers' Dwellings has done a good work in putting up workmen's houses, and in providing for several hundred families. Each habitation consists of one room, one kitchen, and one hall. Some have gardens, and the prices range from 161 to 223 kronen a year ($32 to $45).

The housing conditions in Austria as a whole can not be said to be good, owing to the scarcity of dwellings and the high rents, crowding to many families into a house and too many persons into a room, with all its attendant consequences, but the habitation conditions seem to be improving yearly and both mills and municipalities are working in this direction.

The Government has no old age or invalid pension system, as in Germany, though efforts are being made to get the system established. Several mills, however, have instituted such systems for their own factories, and also have a graduated pension system which is arranged so that full wages are paid after forty years' service.

SHORTER HOURS OF LABOR—CONDITIONS AT VORARLBERG.

In most cases the working time in the mills has sunk below the legal limit of eleven hours. The movement for shorter hours goes on incessantly, especially in lower Austria and Vorarlberg, as well as in the *districts* of Reichenberg and Königgätz in Bohemia, and Brunn in

Moravia, where such movements have been successful and mills now run ten and a half and ten hours and many run only fifty-nine hours or less per week. The inspector of one province reports that the introduction of ten hours in the mills in his province did not result in increased production. I was informed by a manufacturer who tried it at his mill that he found the same result at first, but as soon as the novelty wore off he found he was not getting any more production per hour than before, so he lost in proportion to the reduction in time. Sunday labor in Austria is prohibited. To work at night or overtime textile factories have to get permission of the Government.

Most mills now have kindergartens where small children can be left while their parents are at work. The charge for this is very small. Mills pay off weekly, fortnightly, or occasionally monthly. In some cases mills have arrangements with certain shops and purchases made by hands are deducted by mills, but most mills decline to do this. Formerly the mills stopped one and one-half hours for lunch, but the tendency now seems to be to stop only one hour and get out that much sooner in the evening.

Vorarlberg is quite a textile center for embroidery and for cotton mills making yarn and cloth to be used in the embroidery business. During the prosperous times in 1906 and part of 1907 many embroidery works ran far into the night and many of them worked double shifts. Laborers had to be brought from Lower Austria, the Tyrol, and Styria, but this was unsatisfactory, as they were hard to accustom to the different conditions, especially to the higher cost of living. Others imported Italians, Croatians, and Bohemians. Quite a large number of workmen's houses had to be established. One mill built houses containing five perfectly separated divisions, each division containing three families, so there were 15 families to a house. Along the back of the building were truck farms belonging to the building. The monthly rent for two rooms and kitchen, garden, etc., lighting included, was 12 kronen or $2.44. One large manufacturer left in his will a sum for an endowment fund so that laborers who married after four years should get a marriage portion.

SALES AGREEMENTS.

TRADE REGULATIONS GOVERNING TRANSACTIONS—APPLICATION TO COTTON WASTE, YARN, AND CLOTH.

The following are the rules adopted by the Vienna Cotton Exchange and by the Austrian Cotton Manufacturers Association for the sale of cotton waste, yarn, and cloth, and show the terms and conditions of sale generally accepted by the Austrian trade:

Cotton waste is bought and sold in the home trade and on the Vienna Exchange either according to spinning kind or according to sample. The principal kinds are the following:

Spinnereifäden (spinning threads).
Webereifäden (weaving threads).
Walzenputs (cylinder strips).
Deckelwolle (flat strips).
Kratsstaub (clearer laps).
Durchschlag (picker-room waste).
Spinnflug (spinning fly).
Haspelkericht (reel-room sweepings).
Spinnereikericht (spinning sweepings).
Mischlinge (mixed waste).
Aufgelöste fäden (reworked thread waste).

The price is understood to be per 100 kilos net. The bales in general weigh one-half to one and one-half metercentner (110 to 330 pounds). The tare is deducted from the gross weight of the bales as the actual tare. The packing (sack) is paid for extra by the buyer. In the absence of other explicit conditions the price is understood as cash on receipt of goods, without discount.

Foreign cotton waste is sold according to sample. The following are the principal countries and kinds: United States, linters; Egypt, afrit and mako scart; France, peigneuse and batteur; England, willow fly, stockings, blowings, clearers, and combers. The terms of sale for the direct trade with the United States and Egypt are, as regards weight, tare, price basis, etc., the same as for cotton. The terms of delivery from France are payments in thirty days with 2 per cent discount. The trade with England is according to the rules of the Manchester Exchange for twist, also 4 per cent tare.

The foregoing terms, both for the home and foreign trade, are considered as binding unless there is explicit agreement otherwise:

RULES AS TO COTTON YARN.

Paragraph 1.—Cotton yarn shall be dealt in so long as there is no legal restriction in regard to the same, either by the kilo or by the English pound, or by the bundle of 2.24 or 4.48 kilos. Single bundles in the gray—that is, not bleached or dyed—must weigh without strings or covering 2.24 kilos, and, similarly, a double bundle must weigh 4.48 kilos. In a single bundle there must be five times as many skeins as the number of the hank; in a double bundle ten times as many. Every skein must consist of seven leas. Every lea should average 80 threads, and every thread should be 1.37 meters long.

Gray single cotton yarns, according to the decisions of the international yarn numbering congress now in force, must not have more than 8½ per cent moisture. The yarns are weighed on scales connected with a drying apparatus and dried at a heat of 105 to 110° centigrade (221 to 230° Fahrenheit) up to the weight constancy. The trade weight of the yarn is figured from the dry weight by the addition of the admissible moisture contents of 8½ per cent. This percentage corresponds, regarding the normal condition of the yarn, to moisture contents of 7⅞ per cent.

Paragraph 2.—In the case of bundle yarn, where there is not the correct number of lea bands or length of skeins as above, it can, within four weeks of the delivery of the yarn, be left at the disposal of the seller, if no other arrangement was made at the time of sale.

Paragraph 3.—Claims in regard to weight and differences in yarn numbers, also for too large moisture, are to be made within fourteen days of the transfer of the yarn. Claims in regard to the quality of bundle yarn must be made within fourteen days; in regard to cops within six weeks; after this period no claim can lie. Claims in regard to excessive packing weight must be made within six weeks after receipt of the yarn. Regarding yarn to be sent to another place, the day entered on the bill of lading or waybill is to be considered as the commencing day from which the claim must date.

PROCEEDINGS FOR ARBITRATION.

Paragraph 4.—In cases of claims arising, where buyer and seller have not previously come to a definite agreement as to a certain quantity, the buyer and seller, or the agent of the seller, are together to take from each bale at least one single or double intact bundle, but from every cop case from two different places in the case seven cops must be taken, and together with the buying samples must be laid before the court of arbitration. This collection of samples must take place within fourteen days of the date of claim. Should the seller not comply with the necessary regulations respecting this collection of samples the buyer has the right to take the samples with the assistance of the secretary of the court of arbitration, or of a notary of the same, and he can do this within the following three days. In sampling for the purpose of a moisture test the following will be observed: The samples can only be taken from complete and intact cases which have not previously been opened. Every quality and yarn number must be represented. In lots under five cases two cases are to be sampled; in larger lots one case in every five. Single cases can not be accepted for condition test. The cases of cop yarn selected for sampling are to be weighed and the net weight to be given exactly to the tenth of a kilo. The samples of approximately one-half kilo are to be taken from the inside of the case and to be packed free of light. Of the selected yarn bales a single or double bundle is to be taken out of the middle of the same and to be packed so as to be protected as much as possible from outside influences.

The selected samples, packed as stated and with the seal of both parties affixed, are to be sent by first post to a recognized condition testing house of the Austrian Cotton Manufacturers' Association or to the Vienna Cotton Exchange. With every sample must be given the marks and numbers of the case, amount of invoice, and the net weight. By desire of the buyer or seller duplicate samples can be taken and carefully preserved. Sampling for the purpose of ascertaining the packing allowance must be in a manner according to instructions in paragraphs 1 to 3. From two places in every case some cops must be taken, at least 100 cops per yarn number and kinds—pin cops or warp cops. These samples are to be well packed and sent to the Vienna Silk and Wool Drying Institute or to one of the conditioning houses of the Vienna Cotton Exchange. These houses fix the total weight of the cops, including packing, as well as the weight of the empty cases and packing to the tenth of a gram exactly. All costs of the fixing of the tare, together with any traveling expenses, are to be borne by the party who loses.

Paragraph 5.—Should bundle yarn not reach the normal weight and the difference not amount to 4 per cent the buyer must take the yarn against compensation of the difference in weight. Should this weight difference, however, exceed 4 per cent, the buyer can either demand compensation for the difference or the exact weight to be delivered within four weeks, or he can reject the yarn against payment of all expenses on all the transactions. The annulling of the transaction by a buyer is, however, only allowed when the seller does not agree to deliver, within three days after receipt of the threat to annul, the full weight of the yarn demanded to replace.

Paragraph 6.—The "number" of single gray cotton yarns corresponds to the number of hanks which are contained in an English pound under normal rates of moisture. The number is to be ascertained as follows: In the case of bundle yarns the sample skeins are to be weighed together in sections of five or ten skeins; in the case of cops in lots of twice seven cops, and an entire hank is to be reeled off and weighed at the same time. The average of the numbers so obtained is regarded as the number of the yarns in the respective bales or

cases in question. In case the numbers are rejected all existing cases or bales have to undergo numbering, and the result thus reached is regarded as the average of the numbers for the whole quantity of the rejected yarn shipment which had to undergo sample drawing. Excluded from this averaging, however, are those bales or cases which are found to be under the number to be shipped, as follows: By more than 7 per cent for numbers up to 14s, inclusive; by more than 6 per cent for 14s to 24s; by more than 5 per cent for numbers over 24s. These bales are to be set aside and can be returned by the consignee to the seller on compensation of all his charges. On finer yarns there is no compensation.

The limit in which there is no compensation as to gray numbers is fixed at 3 per cent. If the difference in numbers is averaging more than 3 per cent in yarns up to 24s, inclusive, then the difference above 3 per cent, or in the case of numbers over 24s, the difference above 2 per cent, is to be compensated according to the additional weight of yarn that has to be consumed in manufacturing. The seller, however, does not have to pay compensation if within the time of shipment stipulated ón he exchanges without charges correctly numbered yarns for those rejected, provided the same are as yet unmanufactured into cloth. In case there is a refusal on the part of the consignee to accept the yarn, either on account of too coarse or too fine numbering, the seller has the right to ship, within a fortnight after the end of the shipping term agreed upon, or within a fortnight after the sample drawing is made, correctly assorted yarns in substitution.

Should a difference of numbers be stated at the time the yarns are tested for moisture, which the consignee or the seller can request, in that case a refusal can take place on either one of the two grounds; besides the samples selected for condition test a single or double bundle is to be selected from each bale for number testing, or in the case of cops twice seven cops from each case and the number is to be at once, at the place, fixed by the consignee and the seller or their representatives.

In case there are objections against the correctness of the testing instruments employed (reel and yarn scales), or against the manner of testing, and an agreement is not possible, the decision comes to the court of arbitration. The number agreed upon or decided by the court of arbitration is to be announced to the condition testing institute, which has to state the real number with due regard to the contents of moisture ascertained in case the limit of moisture of 8½ per cent, as given in paragraph 2, is exceeded, and to announce it to the consignee and the seller.

IN LIEU OF SPECIAL AGREEMENTS.

Paragraph 7.—Where there are no special agreements the following shall be understood in regard to cop shell weight: The weight of the paper tubes of warp cops shall not exceed 1.25 per cent and of pin cops 2.25 per cent of the full cop weight (weight of yarn and tube). Owing to the fact that small deviations are unavoidable, the seller can claim excess paper shell tare only when the shell weight, as ascertained according to the last section of paragraph 4, is more than 1.4 per cent of the gross weight for warp cops or more than 2.5 per cent for pin cops, respectively. In case the shells weigh more than 1.4 per cent or 2.5 per cent, respectively, of the gross weight the seller is liable to compensate the consignee for the difference between the shell weight of 1.25 per cent and 2.25 per cent, respectively, and the one actually ascertained and to deduct from the invoice at full yarn value. For throstle crops and other warp cops on bobbins the seller has to compensate the consignee the full bobbin rate less 1.5 per cent, or in the case of pin cops or bobbins the full shell rate deducting 2.5 per cent of the yarn weight (weight of the yarn without shells) at full yarn price. The foregoing regulations do not apply to yarn in stocking yarn twist or to cases in which the consignee stipulates on shipment of a special cop shape.

Paragraph 8.—The condition tests of yarns are made exclusively by the conditioning houses, which are publicly established by the Austrian Cotton Manufacturers' Association or by the Vienna Goods Exchange, the heads of which must be taken on oath according to the regulations prescribed in these organizations. The results of condition tests are to be announced to the consignees, as well as to the seller directly by the conditioning institute. The institute which is to test the yarn for moisture is to be selected before the samples are taken, and by the consignee. Within three days after receipt of the decision on the conditioning either party has the right to claim a second condition test, provided

duplicate samples were drawn. The appointment of the institute for the second conditioning test is for the seller. In accordance with the results of the samples drawn as per paragraph 4, as well as for the statements on the net weight invoiced and charged, the conditioning institute has to state whether there is for the consignee damage by too great an amount of moisture in the yarns, and to what this damage amounts to in percentage. The average of all samples sent in to be tested for moisture is regarded as an average of all the lots rejected without regard to whether or not before sampling a part of the yarn was already manufactured into cloth. In cases, however, where the series is no more complete, the number of cases stated in paragraph 4 must have been sampled, or else the condition test can only be regarded as applying to the quantity existing. In case of a double conditioning test the average of the two tests is authoritative. All charges of the tests, including all eventual traveling expenses, must be paid by the losing party.

COMPENSATION FOR REJECTED YARN.

Paragraph 9.—In case of yarn rejected on account of quality, the court of arbitration has to decide whether or not for the yarn rejected by the consignee another corresponding to the sample or to the sense of the contract is to be shipped by the seller, whether the consignee has to take the yarn on compensation of the loss due to quality, how great the quality damage is, and, finally, whether the contract is to be regarded as void. For quality differences of cotton yarns which are not bought by sample, but by label, mark, or by the denominations of certain manufacturers named specifically before the transaction, the seller is liable to the consignee only inasmuch as the latter can show that the yarn shipped varies materially from the quality of the labels, marks, or denominations in question as it was during the twelve months preceding the contract.

When yarns are sold by samples the buying sample is to be labeled with the date and sealed or stamped by the seller, and is to be given to the buyer in a manner which precludes the confounding or exchanging of same. In all cases where the court of arbitration decides upon the return of the goods the seller has to compensate all charges connected therewith and the damage done to the consignee by the dissolution of the contract in conformity with article 47 of the general conditions for the trade in goods on the Vienna Exchange.

Paragraph 10.—If no shipping time is stipulated upon when making the contract the goods are regarded as to be shipped immediately—that is, shipping can be requested and made at any time. If gradual shipping in a limited time is agreed upon shipments are to be made in almost equal monthly rates. If, however, gradual deliveries was agreed upon without stating the final time of shipping, acceptance has to take place at most in six months from the day of the contract in approximately equal monthly rates. If a contract prescribes consecutive delivery, this consecutive delivery is to be made and taken in approximately the same rates as those immediately preceding. The consignee, in the absence of other agreement, has to hand over the particulars to the seller at least four weeks before the beginning month of delivery, otherwise the latter is liable for no tardiness in delivery. If the consignee neglects to send in the particulars, notwithstanding that he has been requested to do so by a registered letter, the seller has the right to deliver the articles in question after his own wish, within the limits drawn by the contract. If the consignee neglects to give his orders of delivery within five days when also requested by registered letter, the seller has the right after the 15th of the month of delivery to send over to the consignee the wares in question or to store them in a public warehouse situated near his place of manufacture or place of business on the account and risk of the consignee.

WHEN DELIVERY IS DEEMED TO HAVE BEEN MADE.

Paragraph 11.—The seller has fulfilled his liabilities for delivery if he hands over the yarn to the consignee at the latest on the last day of the time of delivery at that place from which it was to be delivered, or if he has handed it over to the transportation company to ship. If the seller has not fulfilled his liabilities of delivery, or the consignee has not fulfilled his liabilities of acceptance, the party which has fulfilled the contract may claim the rights stated in paragraphs 47 to 55 of the general stipulations for the trade of goods on the Vienna Exchange, with the modification that the silent prolongation stipulated in paragraph 53 of the general conditions is extended to four weeks.

Paragraph 12.—The entrance of superior force (force majeur), as far as such renders impossible the delivery contracted, releases the spinner as well as the jobber from the obligation of shipping; the latter party, however, only when selling yarns by certain labels, marks, or denominations stipulated upon in advance. Strikes, epidemics at the place of manufacture, officially ascertained, and breakage of transmission appliances or machines are, under certain circumstances in their consequences in regard to liabilities of delivery, to be regarded as equivalent to superior force, and in case of controversy this is to be decided by the court of arbitration.

Paragraph 13.—Invoices are to be paid, first, (*a*) by cash with 3 per cent discount within thirty days after the date of invoice; (*b*) with bill of acceptance of six months, or acceptance of four months and 1 per cent discount from the invoice date; (*c*) on open account, five months from date of invoice. Second, if one monthly invoice is produced on all shipments in the course of one month or cash or acceptance monthly is agreed on all invoices produced in the course of a month, (*a*) cash payment has to be made up to the 20th of the month following the month of delivery; (*b*) the time of currency of the monthly acceptance begins on the last of the month of delivery; (*c*) the currency of the four months' open account begins on the last of the month of delivery, so if the consignee states in the cash business the time of payment, the amount is due at once and the cash discount ceases, but he gets 5 per cent interest for the time elapsed, calculated from the date of payment up to the close of the four months' limit. Third, if the consignee was permitted to choose between the acceptance or cash payment, or if acceptance only was stipulated upon, the acceptance is to be sent in at least by the 20th of the month following the delivery. Should the consignee omit or neglect this, especially if requested by registered letter, the amount of invoice without cash discount, a compensation of 5 per cent calculated from the date of payment up to the elapse of the four months' term, is payable at once if the acceptance is immediately sent in. Fourth, by cash payment is understood payment in cash, transmission by indorsed checks on banks, checks on postal savings banks, or other checks. Checks and indorsements must, however, be due at the time stipulated for cash payments.

Paragraph 14.—If there is no other agreement for cops of inland origin, packed in cases or boxes, 1.4 hellers per English pound or 3 hellers per kilo are to be charged for packing.

Paragraph 15.—Charges for transmission into the house, store, or to the forwarding agent of the consignee are, in Vienna, to be paid by the seller. On shipments to the provinces, charges for forwarding and transmission to the respective transportation companies are paid by the consignee.

COTTON WEAVING, GRAY GOODS.

Paragraph 1.—All goods woven from raw cotton yarns which are not yet manufactured are dealt in per meter, if there is no other agreement either by samples (pieces, strips, or cuttings) or by designation of the make-up, the yarn number, width, and approximate length of the cloth. If there is no agreement as to the length of the cuts the following lengths shall be understood: For calico, molinos, percales, etc., an approximate length of 120 meters; for printed barchent, approximately 90 meters, and for domestics and inlets, between 50 and 60 meters per piece. The make-up is designated by the number of warp and weft threads which are included in a quarter of an inch (old Viennese measure) or to a centimeter of the cloth. The width of the cloth is expressed in old Viennese inches or in centimeters.

Paragraph 2.—In the delivery of gray goods, when there is no other agreement, only cloths manufactured on mechanical looms from cotton yarns are to be understood.

Paragraph 3.—Claims for delivery not in accordance with samples or for differences as to the make-up, width, length, yarn numbers, and yarn qualities must be made by the consignee at least within a fortnight after delivery else the liability of the seller ceases. As to goods sent to another place, the date of the arrival at place of destination stated on the invoice is regarded as beginning the time of claiming.

Paragraph 4.—In examining into a claim, if the seller and consignee have not agreed upon a certain quantity, 10 per cent of the rejected goods, but not less than 10 nor more than 100 pieces, together with the actual samples, in case there are samples (sample pieces, strips, or clippings) are to be presented to the court of arbitration. Rejected pieces of not more than 10 are to be presented in full. The selection of the pieces to be judged has to be made by the

seller in common with the consignee or by their representatives within fourteen days from the day of claim. In case the seller does not do what is necessary in this connection the consignee has the right within the next following three days to have sample pieces taken from the rejected bales by the secretary of the court of arbitration or by an imperial notary public. Should the parties not agree upon the selection of the sample pieces the same are likewise to be taken by the secretary of the court of arbitration or by an imperial notary public and the average of all the samples is to be considered the average of all the existing quantities of the rejected goods.

WHERE NO SPECIAL AGREEMENT EXISTS.

Paragraph 5.—If there was no special agreement between the seller and the consignee with regard to the permissible difference in the make-up, all kinds of gray goods may be delivered as to warp as well as to weft, with full number of threads from correctly numbered yarns, but with due regard to the technically unavoidable limits of mistakes. Differences in width up to 1.5 per cent existing in not more than 10 per cent of the entire quantity does not give the consignee the right to reject the goods, but the seller is compelled to compensate the consignee for the percentage of difference in width as ascertained up to this limit. If there is a difference in width up to 1.5 per cent, no more than 5 per cent of the resulting quantity of the goods are to be taken over without right of compensation. Goods of better quality than contracted for can not be rejected, insomuch as they do not materially vary from the stipulations prescribed in the contract, but the consignee has no right to claim compensation for better goods delivered.

Differences of make-up, yarn numbers, and quality are to be decided by the court of arbitration in case of controversy. If the latter thinks that there is a difference it may nevertheless decide that the consignee has to accept the goods on compensation for the smaller value than contracted for. If the decision reads that the goods be not taken over, the consignee may nevertheless, on his own desire, accept the goods on compensation of the smaller value of the same as decided by the court of arbitration, or he may return the same to the seller on settlement of all the charges connected therewith. In the latter case the consignee has the right, first, to insist on fulfillment—that is, to request shipment of an equivalent quantity of goods as contracted for within six weeks; second, to desist from the contract by canceling the shipment in question and thereby shorten the whole contract; or, third, to request compensation for the damages that can be shown.

If the consignee wishes to desist from the contract or to request compensation for loss on account of nonfulfillment, he must announce it to the seller, leaving a proper time, which should be decided by the court of arbitration in case of controversy, for delivery of goods as contracted for. If this time for later delivery has elapsed without result, or if the compensatory delivery does not fall within the contract, then the contract is considered void and the seller becomes liable for compensation of damages. In case of cancellation of the contract the liability for damage can not, if the contract was to be fulfilled in several sections of time, be referred either to the shipments formerly properly fulfilled or to those due later on.

DIFFERENCES IN WEIGHT AND QUALITY—DELIVERY.

Paragraph 6.—On contracts where the weight per piece is stipulated, on differences of weight up to 3 per cent over or under the limits stipulated, can not be considered grounds for rejection, and no compensation whatever is to be paid by either party.

Paragraph 7.—On contracts which are not made by sample, but on the regular brand of the seller, or by the denomination of certain manufacturers specially named before contracting, the seller is liable to the consignee for differences of quality only inasmuch as the latter can show that the goods delivered materially differ from the quality as it was averaging during the last six months preceding the contract.

Paragraph 8.—On contracts by samples the buying sample labeled with the date and sealed or stamped by the seller in a manner precluding confounding or exchanging is to be given to the consignee to file.

Paragraph 9.—In case there is no certain term of delivery agreed on when contracting, the goods are considered to be delivered at once—that is, fulfillment can be requested and made at once. If gradual delivery within a certain

time was agreed on, delivery has to take place in approximately equal monthly parts. If gradual delivery was agreed on without indicating the final time, delivery has to take place at most within six months from the date of contract in approximately equal monthly parts. If the contract is for consecutive delivery this contract is to be fulfilled and accepted in approximately equal periods as that immediately preceding it.

Paragraph 10.—In case there is no other agreement the seller on time contracts has fulfilled his contract as to deliveries if he has delivered the goods not later than the last day of the term of delivery, at that place from which they were to be delivered into the hands of the consignee, or to the transportation company or forwarding agent. If the seller has not fulfilled his liabilities of delivery or the purchaser has not fulfilled his liabilities of acceptance the party which has fulfilled the contract is protected by the rights given in paragraph 47 of the general goods trade rules of the Vienna Exchange.

If a contractor desires to cancel the quantity not delivered or accepted, respectively, or to claim damages, he has to inform the other party by registered letter, and is compelled to allow the tardy party proper time of prolongation if no exactly determined time of delivery was agreed upon and if the nature of the contracts permit so to do. If on time contracts, after a lapse of the delivery time agreed upon, a part of the quantity contracted for has not been delivered or accepted, respectively, because neither the seller insisted upon acceptance of the goods nor the consignee required shipment, a silent prolongation takes place, and the rest of the contract in regard to quantity and time is to be fulfilled with shipments averaged in the same way.

TARDY SHIPMENTS—COST OF DELIVERY.

Paragraph 11.—If a contract has been made for certain time of delivery, but with open particulars, the purchaser in the absence of other agreement has to mail the particulars to the seller at least eight weeks before the beginning of the month in which the term of delivery in question is ended, otherwise the latter is liable for no tardiness in shipment. In case of tardy shipments the seller has the right to fix the time of fulfillment of the invoice corresponding to the time of delivery originally contracted for. If the purchaser omits to send off the particulars in time, although specially requested so to do, the seller has the right to fulfill the contract in any make-up, width, and yarn quality which corresponds to the price basis of the cloth. If no price basis has been agreed upon, but the prices for the different kinds have been agreed upon, and the buyer, in spite of the demands from the shipper for particulars in regard to the amounts to be delivered of the various kinds, fails to comply, the shipper has the right to deliver the quantities of the various kinds ordered according to his own wishes.

Paragraph 12.—In so far as superior force makes the contracted deliveries impossible this relieves the seller and the manufacturer and also the seller of foreign products from the necessity of delivery, but the latter only insomuch as it is a question as to the delivery of goods made in the factory of the particular manufacturer mentioned. In how far strikes, epidemics, officially ascertained, or breakdown of machinery or of transmission appliances have action upon the necessity of delivery is, in case of controversy, a question for the court of arbitration.

Paragraph 13.—If nothing else has been agreed upon for delivery of gray goods, six months' time is understood as the usual conditions against acceptance, from the date of invoice or cash, with a 3 per cent discount within fourteen days from the date of invoice. Settlement is to be made at the domicile of the seller.

Paragraph 14.—The cost of delivery of gray goods into the house, warehouse, or to the forwarding agent of the buyer in Vienna, on the Vienna Plaza, must be borne by the seller. In case of shipment of goods to the provinces the costs of delivery of forwarding is to be settled by the buyer.

REPORTS FROM CONSULAR OFFICERS.

CARLSBAD.

EXTENSIVE COTTAGE INDUSTRIES IN THE DISTRICTS OF BOHEMIA.

Consul John Steel Twells, in the following report from Carlsbad, minutely describes the cottage industrial life in that part of Austria, so many of the products of which are sold in the United States:

In the manufacturing districts of Bohemia goods for both home supply and exportation are not only produced in factories, but to a great extent the raw material is given to men, women, and children and taken home, where all members of the family engage in the work of producing various articles which are sold to the home trade or exported to the foreign countries.

This method is known in Austria as "Hausindustrie," or home work, and in all parts of the country where textiles, glass, lace goods, gloves, etc., are made, men, women, and children obtain their simple living by this means, and consequently it is of great importance to thousands of poor people living in the small villages adjacent to factory centers, enabling them to make a living, especially during the long dreary months of winter, when no other occupation is possible. Around perhaps the only table in the only room, in a little house, the family assemble, the man, his wife, the grandparents, and children with other members of the family, if there be any. When evening comes on, an oil lamp, a candle, or even chips of wood are the only lights by which they can work. On Thursdays, Fridays, and Saturdays the finished articles are taken to the factories and paid for.

"It is very hard now," said one of the lace exporters from Neudek the other day, "to get people in summer to make laces. They prefer to go to work in fields or picking hops, for which they get higher wages than by making laces. Children get 8 cents a day at that time and adults from 25 cents to even 40 cents, and of course we can not afford to pay such high wages for lace making."

GOVERNMENT INTEREST IN IMPROVEMENT.

The Austrian Government, desirous of improving this sad condition of laborers, is at present preparing a new law which has been handed to the chambers of commerce for their consideration and judgment. The following gives the numbers of persons in Bohemia who do home work:

Aussig	667	Leipa (cloth, linen)	3,916
Braunau (linen)	4,786	Leitmeritz	210
Dauba	54	Reichenberg	2,256
Deutsch Gabel (weavers)	4,695	Rumburg (weavers)	7,819
Friedland	498	Senftenberg (textile, linen)	10,054
Gablonz (glass beads and cheap jewelry)	9,147	Teplitz	1,378
Hohenelbe (textile)	2,514	Tetschen (buttons, linen)	3,068
Koeniggraetz	1,182	Trautenau (linen)	4,936

In the district of the Chamber of Commerce, in which parts of the consular districts of Reichenberg, Carlsbad, and Prague are situated, 105,897 persons do such home work as has been described. They constitute more than one-fourth of the entire population of that commercial district. In the Reichenberg section 68,649 persons are engaged in home work, i. e., outside the factories. They make mostly textile goods, but also embroidered, knitted, worsted, and crocheted goods, which are more or less dependent upon the textile trade.

Next comes glass, stone, earthen ware and clay goods, in which 16,596 are engaged; three-fourths of these workers belong to the glass trade, which is one of the oldest home industries of Bohemia; 8,168 persons make stays, gloves, head covers (caps, hats), and 8,168 do cleaning work at home; 6,427 make wooden, matted, turned, and carved goods; and 3,320 metal goods, chiefly metal turners. In the Erzgebirge, which belongs to the consular district of Carlsbad, 6,000 persons are engaged outside the factories with straw and bast platting. The raw material—simple wheat straw—comes from the hop district of Saaz, while bast or wooden chips are made from Russian ebony wood.

NUMEROUS ARTICLES OF PRODUCTION.

In the district of Senftenberg are located the basket makers and the reed twisters. Mats, pockets, and slippers are made of reed, rush, etc., which are likewise used for building purposes, especially for reed mats, and articles for smokers (cigarette and cigar holders, etc.). In northern Bohemia and also in some southern parts of Bohemia, as in the districts of Muenchengraetz, Neupaka, and Senftenberg, are the shoemakers' villages and towns, mostly inhabited by workers who make parts of shoes at home for the wholesale makers.

Their goods are called "market goods," because they are exhibited and sold on stands at the fairs in the larger manufacturing districts which are held every week or month, or several times in the year, especially in the districts of Bohmisch-Kamnitz, and at Bensen, Tetschen, and Schluckenau. Wooden slippers are made in the district of Rumburg; braces at Teplitz; gloves at Bilin, Kaaden, and at Prague, also at Joachimstal and Abertham. At Schoenau and Hainspach (district of Schluckenau) the ribbon weavers are located, and in a southwestern direction from Rumburg are the wood weavers or makers of Sparterie goods, while at Rumburg and Bohmisch-Kamnitz are the smoking-pipe makers.

In many of the forest villages barrels are made, which trade is largely encouraged by the chemical factories at Aussig, that employ several thousand workmen. In the southwestern districts of the Boehmerwald are many hundred makers of chip boxes; they make also agricultural and kitchen goods of wood, frames for brushes, toothpicks, and wood carved goods. Altogether about 3,000 makers of wooden goods are scattered in the various villages of southern and northern Bohemia.

CONFORMING TO CHANGING DEMANDS.

Other kinds of home work depend upon the factories near the villages. In the Riesengebirge paper bags and horn or stone buttons are made; near Reichenau and Gablonz snuffboxes were formerly made, but when the use of snuff decreased a new trade began, viz, the mak-

ing of cheap oil paintings on wood, tin, and linen. This developed from the little paintings which were formerly made on the snuff-boxes; the paintings were enlarged and the new industry of making oil paintings was started. The emigration to the United States from Bohemia is partly connected with this kind of work. If the market is good, then all the family works day and night and makes a living, but if the market is bad, they lose their employment and lead a very poor life. The wages are extremely low. In the Adlerhills weekly wages of $1 to $1.20 are paid, but as there are many weeks during the year when no work can be had the average weekly earnings are not larger than 80 cents. In good times husband and wife work alternately eighteen hours a day. If the scanty habitations, the rough climate, and the poor soil are taken into consideration, some idea can be gained of how great is the poverty in these mountain villages. Yet it is considered of great value that chip-box making has been introduced, because the workers, mostly women and children, earn 80 cents to $1.40 per week; and linen-shirt buttons are now made, by which wages of 60 cents to 80 cents a week are earned. Weavers who make at home silk and Jacquard and art work earn $1.40 to $4 a week. The straw and bast matters earn from 20 to 40 cents a day, but after the "season" the wages are lowered. Wood carvers earn $1.20 to $2.80 a week, and the brush makers at Gabel from $1.60 to $2 a week. The wood carvers at the Wittigtal earn $1.60 to $3.60 a week, and the wood and mat makers at Niemes from $1.20 to $1.60 a week.

INCREASING INCOME—ADJUSTMENT OF INDUSTRIAL RELATIONS.

In this consular district home work is often done to increase the income. People go to work during daytime and in the evening they spend their time by making certain goods. The artificial-flower makers earn $1 to $2.40 a week. At Prague and Joachimstal, Abertham, etc., in the consular district of Carlsbad, gloves are made. The manufacturers hand the leather out to contractors called "Natfaktoren," who distribute the work among the people. Hundreds of women are thus employed in this district who earn $1.20 to $1.60 a week. There are other female home makers of straps, whip makers, cutters of visors for caps, and umbrella makers.

To many thousands of persons home work gives employment. There are districts in which the population lives entirely from this kind of work, and although they make a poor living it is a benefit to them. On the other hand, it must be admitted that home work strongly competes with the smaller manufacturing trades. In Vienna, for instance, there are 100,000 to 120,000 home workers making shoes for factories. There are three classes, viz: (1) Masters who work with assistants; (2) journeymen who work for weekly wages and take on assistant hands, the latter getting food and lodging and very small wages, and (3) "Pfuschers" who work without assistants.

The difficulty with which the Austrian Government has to cope is that the small trades people have great difficulty to compete with home work. Many thousands of both classes make an honest living, but one class is pressing the other, and now the Austrian Government is studying a problem to regulate home work in such a way that it will no longer affect the small manufacturing trades.

PRAGUE.

INCREASE IN SPINDLES, LOOMS, AND MACHINERY IN RECENT YEARS.

Replying to an inquiry, Vice-Consul Arnold Weissberger, of Prague, furnishes the following information concerning the textile industry of Bohemia:

There has been an increase of about 700,000 spindles and 20,000 looms in the cotton industry of Bohemia during recent years. There was also large additions of machinery last year, but the extent is yet impossible to obtain.

With the exception of auxiliary hands, all cotton-mill operatives are paid by contract, and their daily wages average as follows:

Class of workers.	Wages.	Class of workers.	Wages.
Spinner.....male..	$0.80	Weaver.....male..	$0.40
Piecer.....do....	.50	Piecer.....female..	.44
Drawing-frame attendant.....female..	.45	Warper.....do....	.44
Auxiliary employees.....	.50	Bobbin-machine attendant.....	.40
Throstler.....female..	.48	Overseers.....	1.00

The hours of labor are generally ten per day. Some spinning mills are working day and night, with double shifts of employees, of ten hours each shift.

It is difficult to obtain general information regarding the housing of operatives. In some dwellings the rooming space costs from 50 to 60 cents per square yard, or from $12 to $16 per room per year. As a rule, the operatives are crowded into small places, say 8 or 9 persons to about 30 square yards. In the country the dwellings are rather cheaper. The style of living depends chiefly on the number of breadwinners in a single family and their income. In the mountain districts the majority of the operatives live on coffee and potatoes chiefly, but in the city and in the open country living conditions are somewhat better.

MILL OPERATIVES AND MACHINERY.

In weaving mills one operative tends 3 looms on plain cotton goods, 2 looms on fancy goods, and 1 loom on heavy goods. In isolated cases, when mills are fitted up with Northrop looms, a weaver and one assistant tend 12 looms. These looms have found as little favor as the various English self-acting looms. In the spinning department each machine is tended by one operative, and in the warping department one operative tends from 12 to 15 spindles.

In spinning mills with self-acting machines four operatives are put down to 2,000 spindles, with flyers one operative to 300 spindles, and with throstle frames one operative to 500 spindles.

In the spinning mills English machines are generally used, although some mills are fitted with Alsatian machines. The only machines built in Austria are those for waste spinning. In the weaving mills the power looms are mostly Austrian manufacture, but many English looms are in use. The sizing engines are chiefly English, but a few Alsatian machines are in use. The warping machines are English.

As to speed of machinery, it is estimated that small cotton looms make 180 to 190 revolutions per minute, broad, smooth looms about 160, and Jacquard looms 140 to 150. [Samples of textiles from Prague are on exhibit at the Bureau of Manufactures.]

REICHENBERG.

WAGES IN A KNITTING, LINEN, AND WOOLEN MILL.

Consul Charles B. Harris furnishes the following information concerning the wages paid in the leading textile industry of Reichenberg. The table shows wages paid overseers and operatives in the north Bohemian textile mill:

Operatives.	Weekly wages.	Operatives.	Weekly wages.
Woolen blankets and carpets:		Woolen and half woolen ladies' cloth:	
Mechanical and hand weavers—		Male	$5.07
Overseers	$6.00 to $7.10	Female	2.03
Operatives—			
Male	2.23 to 6.29	Cotton and woolen knitting:	
Female	2,23 to 4.06	Male	$2.40 to 3.00
Finishers	4.26 to 5.28	Female	1.80 to 2.40
Spinner's assistants—		Piecework—	
Male	2.03 to 5.98	Male	3.00 to 4.80
Female	1.82 to 3.65	Female	2.76 to 3.00
Draftsmen—		Linen department:	
Male	3.65 to 7.10	Male	2.04 to 3.60
Female	3.65 to 4.26	Female	2.16 to 2.40
Operators under ninteen years—		Piecework—	
Male	1.01 to 2.82	Male	3.00 to 4.80
Female	1.01 to 2.43	Female	2.16 to 3.00

Payment of wages is made each Saturday. The mode of payment generally in vogue is by pay roll of 10 or 12 names. The total amount, with the pay roll, is handed to the overseer, who pays each operative the amount set opposite his name. A few factories use the envelope system, while at other factories the operatives call at the office for their wages. The hours of labor are ten.

Manufacturers are compelled by law to insure their employees against accident and sickness. [Samples of Bohemian textiles transmitted by Consul Harris can be seen at the Bureau of Manufactures.]

HUNGARY

COTTON FACTORIES.

INDUCEMENTS TO ESTABLISH MILLS—INCREASING SPINDLAGE—PRESENT CONDITIONS IN THE INDUSTRY.

Cotton manufacturing in Hungary is as yet in its infancy, but it is interesting to note the great inducements offered by the Government to accelerate its growth. For patriotic reasons the people wish to be at least economically independent of Austria and are sparing no pains to foster home industries.

Rozsahegy (German name Rosenberg), in the northern part of Hungary, is so far the main cotton manufacturing center and contains about half the cotton spindles. This industry is succeeding to the hand-loom weaving that was formerly established in this district by Saxons. Besides Rozsahegy the mill towns are Budapest, Dugaresa, near Trieste, and Rozsony, which lies just across the border near Vienna. The largest company is the "Ungarische Textilindustrie Aktiengesellschaft," which was founded at Rozsahegy in 1894, and now has two spinning mills of 50,000 and 54,000 spindles, respectively, or a total of 104,000 spinning spindles, 7,000 twister spindles, 1,250 ordinary looms, and 900 Northrop looms. These latter were made at Rozsahegy under the patent bought from the Draper Company. The next largest company is the "Ungarische Baumwoll Industrie Aktiengesellschaft," or, as it is known by Hungarians, the "Magyar Pamutipar R. T.," at Budapest, which has 13,792 spindles and 340 looms.

The present (January, 1908) status of the Hungarian cotton manufacturing industry is furnished to me by the Hungarian Department of Commerce as follows:

Description.	Number.	Spindles.	Looms.
Spinning mills only	2	65,120	
Spinning and weaving mills	3	85,040	2,126
Weave mills only	14		2,953
Thread mills	3	20,000	
Waste spinning mills	1	1,300	
Total	23	171,460	5,079

The present consumption of cotton is about 50,000 bales a year. As yet the mills are mainly on coarse goods, Cabots and some colored goods. The ones that make finer goods have to send the cloth to Bohemia to be bleached.

SKILLED HELP OBTAINED FROM AUSTRIA.

The Hungarian mills suffer from the disadvantage of starting in a new section and away from the various machine shops, yarn agencies, bleacheries, and the allied industries that gather around mill centers. The Hungarian operative is also inferior to the Austrian, as he is unaccustomed to machinery. For this reason the mills are forced to import Austrians for the more skilled positions, and these are obtained from the mills just over the border by offering special inducements, such as higher wages, free transportation, etc. This borrowing of their operatives is not relished by the Austrian mills, but they can not help themselves. Even with the help of a partial force of Austrians the Hungarian mills find it difficult to get results equal to those of Austrian mills. The mills at Budapest have the advantage of cheap water communication down the Danube with Turkey and the Balkans, but otherwise the new cotton mills need all the concessions granted them by the Government to enable them to succeed.

The help question is one of the most important, and not only the cotton mills but the great flour mills and other Hungarian industries are beginning to feel the drain caused by the departure of so many emigrants to America. Just at present, on account of the money crisis in America, there has been a return tide of the floating class, but most of these will return to America as early as conditions permit. One mill manager referring to such returned workers said that they had been spoiled by the American life; that before they left they were tractable workers, and recognized that the man who paid them was their superior, but that now they regarded themselves as fully equal to anyone and were very hard to manage.

ENGLISH MACHINERY USED—THE WAGES PAID.

Most of the Hungarian mills use English machinery and are one-story mills. The Magyar Pamutipar mill at Budapest is a good type of the new mills now being started in Hungary. This mill has 13,392 spindles and 340 looms, but is being enlarged to 30,000 spindles and 500 looms. The mill is one-story with posts made up of two iron channel beams placed back to back, has the usual cement floors, and saw-tooth roof throughout. This mill mixed sawdust with the cement so as to make a floor with a little more "give" in it, and one that would not be so cold for the help to stand on. Most of the machinery is from England, but some is from Germany, while the boilers and engines were made in Budapest. The looms are the overpick type and the spinning frames have the English system of top rolls. Cloth is measured in centimeters, but, as is the case in Italy, Switzerland, and Austria, the yarn numbering is on the English system and the clocks on the speeders, etc., read in English hanks of 840 yards. The wages paid at this mill are as follows:

Picker hands: Men, 2 crowns (crown=20.3 cents); women, 1.5 crowns a day.
Cards: 2.6 crowns (8 cards to a man); card grinder, 4 crowns.
Draw frames: 1.5 crowns on the average, paid by hank clock.
Slubbers: 2 crowns a day average, paid by hank.
Mules: Two mules (2,000 spindles) on No. 20s require 1 spinner, at 5 crowns; 2 piecers, at 3.50 crowns, and 2 boys, at 2.50 crowns.
Ring spinning: Girls run one side of 200 spindles each, get off about 8 hanks a day, and are paid 1.2 crowns to 1.4 crowns a day; they do their own doffing.

Reelers are paid by the pound and make 1.5 to 2 crowns a day.

Weavers run mostly on Cabots; they are paid 2 crowns for 100 meters (meter=39.37 inches) of 15 pick (per quarter inch) goods, and other cloth in proportion.

Coal costs this mill 96 heller per 100 kilos, which is only $1.95 a ton, but is Hungarian coal of only some 4,500 calories. The mill is now erecting a large brick tenement house within the mill grounds for the operatives. Each family will have a large room, a kitchen, and a small room, at a cost of 2 crowns per week, and the mill intends also to furnish them with provisions and with coal at cost. The mill is building this at considerable cost so as to secure a class of steady help. The object in view is that the operative shall give his entire thought to his work and that the mill will furnish him with everything needed and look after his wants completely.

THE HAND LOOM STILL FLOURISHES—HOUSING WORKMEN.

This mill besides its cloth sales has a yarn production that it sells to hand workers. Robert Weiss, the treasurer, stated that there are required for the hand-loom weavers 15,000,000 pounds of bundle yarn yearly, part of which was supplied by Hungarian mills and part imported. Hungary is one of the countries where the hand loom still flourishes and there are quite a large number, especially in the sections farthest removed from the large towns.

Some of the mills furnish houses for their operatives and some do not. One manager with whom I talked thought that it was best for the hands to find their own lodging places, for when mills furnished houses it tended to concentrate the help in one place and so accentuate class interests. At Budapest there is a company organized especially for building homes for workingmen, and they have recently built 100 in the neighborhood of two textile plants. Each single house contains one large room, kitchen, pantry, and attic, and there are 120 square meters of land rented with the house. The rent of each house is from 265 to 285 crowns ($54 to $58) a year.

The Hungarian mill families as a rule live in very crowded quarters and their fare is exceedingly simple, meat or eggs being very rarely indulged in, but the conditions of life are better than those that obtain on the farm in most parts of the country, and the operatives are fairly well satisfied. Though taken all in all the cotton-mill hand with his steady work has a better existence than the farmer, there seems to be a tendency among the people to class factory work as lower than farm work, and this operates in many cases against the mills obtaining a full supply of local help.

CARING FOR OPERATIVES—IMPORTING HELP.

The operatives have their own sick-benefit societies. One textile manufacturer has also instituted a pension system for his employees. The company sets aside every week a sum equivalent to 8 per cent of its pay roll for this fund. Any employee found medically unfit after ten years' work will be paid a pension of 30 per cent of his regular wages, and his pension will be increased 2 per cent for every year worked over ten, so that for twenty years' work the pension will amount to half pay and for forty-five years' work will be full pay for the remainder of his days. This mill also has a special pension fund for its officials, but with the exception that they are required to

furnish half and the mill half of the amounts set aside every month for this purpose.

Mill men complain of a lack of labor everywhere. In Transylvania there is the peculiar situation of laborers going elsewhere for work, when their own industries are crying out for labor. There are Szecklers (Magyars), Saxons, and Roumanians in this district, but the Szecklers are of a migratory disposition and had rather go to Roumania and work part of the year there than work steadily in one place, so for regular work the mills have to import help from as far as Italy and Macedonia.

STRIKES ATTRIBUTED TO AMERICAN INFLUENCE.

Though the cotton mills are small, the labor question with them is already a vital one. Labor throughout Hungary is beginning to organize, and there are an increasing number of strikes. The strikes have ceased to be simply for shorter hours and higher pay, but have become an instrument in the fight for political power by the labor unions. The walking delegate is in course of development, and in nearly all cases one of the main demands of the strikers is the recognition of the union. They also demand that any foreman obnoxious to a majority of the workers be discharged, that the plant be shut down on May 1, "Labor Day," and also on special occasions when the unions desire to make political demonstrations. The employers call the spread of the union system the "American influence," and are very much opposed to it. The department of commerce, in its inspectors' reports, advised the manufacturers to organize to meet the workmen's organizations, and this is now being done in all branches. Some of these organizations extend throughout the country, so that in case of lockouts the laborers can not obtain work at any mill in Hungary.

THE DUAL MONARCHY.

Hungary and Austria, while nominally united in a dual monarchy, are really on a treaty basis. According to the new law which came into effect in January, 1907, "all of the industrial requirements of the State, and of municipal authorities, parish councils, or of any institute or institutions maintained or subsidized by the same, and of all home enterprises engaged in the service of public traffic, must be supplied by the industry of the countries of the Holy Hungarian Crown." Exemption may be granted only in individual cases where there is some special reason.

To insure industrial development of the country, the Government offers to remit taxes and duties, haul at cost on state railways, and in some cases to grant subsidies to new enterprises locating in Hungary. The concessions granted are very similar to those being granted by the Italian Government to new mills in southern Italy, but are even more favorable in their scope.

According to the law above quoted favors are to be granted to "manufacturing enterprises (factories) recently established in the lands of the Holy Hungarian Crown and equipped with the latest appliances of technical art, which produce articles not hitherto produced at all by manufacture in the said lands of the Holy Hungarian Crown, or at any rate not in sufficient quantities practically to satisfy

the demand, or which produce articles the increased production of which is desirable from an economic point of view." This law is applicable to all new factories, but under its application cotton manufacturing is especially favored.

CONCESSIONS TO COTTON MILLS.

Among the concessions granted to new cotton factories are the following:

1. Exemption from the payment of direct state taxes due on the output of the factory, and exemption from all municipal and parish dues imposed on those paying the said direct taxes. This also includes exemption from the payment of tolls levied by the Royal Hungarian minister of agriculture, either directly or indirectly, on state highroads and bridges, and in state roadsteads or harbors.

2. Exemption from the payment of Crown (treasury) and parish dues and charges exacted for the acquisition, lease, and transfer of factory sites and buildings, and of all machinery constituting an appendage thereof, as well as for the registration of the lease, and of all equivalents of the same; further, if the said enterprises take the form of limited liability companies or cooperations, or if, during the period for which the favors granted are in force, they be transformed into limited liability companies or cooperations, or be reorganized or become associated with other companies, they may, in addition, be exempted from the payment of stamps and dues, parish dues, and charges on contracts executed on the occasion of the formation of the company, the increase of the capital of the company, and the issue of shares or preference shares, whether such be issued on the formation of the company or later on with a view to increasing the capital of the company, and on all other deeds executed in connection with the said contracts, on all legal transactions referring to the paying in of shares or preference shares as well as of cooperation debentures and on all documents relating to the same as well as on the transfer of any property executed for that purpose.

3. All building materials required for the construction or expansion of factories and industrial establishments, as previously mentioned, shall be conveyed by the state railways or railways subsidized by the state at a rate covering only the working expenses, as well as all machinery and parts of machinery required for the equipment of the same, and in general all articles of equipment. Side tracks and short industrial lines required by said enterprises shall be built by the state at cost. Any shunting executed for said enterprises shall be at cost of merely the working expenses, or they may be specially exempted from all shunting charges for a certain period.

LIBERAL INTERPRETATION OF THE LAW TO BENEFIT MILLS.

In interpreting the above the Minister of Commerce ordered:

The freight charged for the articles above enumerated, which shall be carried by slow freight trains, shall be, if they belong to Class A, i. e., "sundries," in cases where charges are paid for at least 5,000 kilograms (5 tons) per car and letter of conveyance, a unit of 32 fillers (6.4 cents) per 100 kilograms (220.4 pounds) per kilometer, a charge of 8 fillers (1.6 cents) per 100 kilograms for "terminals," and

other charges payable on the basis of the legal freight dues; if, however, the articles in question belong to any other freight class, in cases where charges are paid per gross weight for at least 10,000 kilograms per car and letter of conveyance, a unit of 20 fillers (4 cents) per 100 kilograms per kilometer, a charge of 4 fillers (0.8 cent) per 100 kilograms for "terminals," and the other charges payable on the basis of the legal freight dues. The smallest charge per 100 kilograms shall be 8 fillers (1.6 cents). For the conveyance of goods on industrial lines connecting factories with the nearest railway station the "working expenses" to be charged shall correspond to 50 per cent of the regulation charges in force on the state railways and railways enjoying a guaranty of interest on the part of the state. In cases where only working expenses are charged, the loading and unloading of the goods shall be carried out at the cost of the party enjoying the concession.

The reduction in freight stipulated above generally takes the form of a refunding of the surplus over working expenses.

4. Permanent exemption from house rates is given to all dwellings of workmen built by the factory in conformity to the requirements of hygiene, which are offered to laborers as part payment of wages, or on condition that a certain part of their wages shall be devoted to the payment of rent or the acquiring of said dwellings on the hire-purchase system. Also all dwellings built by outsiders for the use of workmen as above may be exempted from all house rates for a period of twenty years.

This exemption from house rates includes not only house rates, but also the general income tax levied in proportion to the same, the national additional tax for the relief of the sick (sick relief fund), and all other public and parish dues contingent on the said house rates.

STATE SUBSIDIES IN ADDITION TO CONCESSIONS.

Besides the concessions granted above, the Minister of Commerce is authorized, where cases of general interest render the creation, expansion, or maintenance of a certain industry desirable, to concede a State subsidy to certain enterprises in the form either of a lump sum or an annual subvention, payable for a certain number of years, or to promote the creation of such enterprises by the offer of state support by participation. Under this law the new cotton mills are being granted a subsidy equal to one-fourth of their capital stock, and this is paid to the company in ten yearly installments.

The granting of any or all of the concessions described may be petitioned for within one year of the day on which the factory started work, and the minister may also guarantee the granting of concessions even before the factory is established. Favors granted are for a period of fifteen years, except where otherwise stated. A petition may be presented for the prolongation of favors enjoyed after the latter have become invalid, but any such petition must be presented within one year after the concession previously granted expires.

An essential condition of any concession is that three-fourths of the workmen and officials shall be Hungarian citizens. Furthermore, factories or industrial establishments enjoying such favors are bound

to procure all the articles for building and equipment, as well as the materials and half-finished products required in working, from home factories and producers, provided such are made or produced in the required form in the lands of the Holy Hungarian Crown. In cases where exemption is justified the minister of commerce may grant exemption.

In 1900 there were 80,000 spindles in the cotton mills of Hungary; at the present time there are in operation and in course of erection 200,000. It is expected that the government aid now being extended to the mills will result in the industry being largely increased in the next few years.

SWITZERLAND

COTTON GOODS PRODUCTION.

SLOW PROGRESS IN MANUFACTURING—CONDITIONS AMONG THE MILL OPERATIVES—A TARIFF FOR PROTECTION.

The cotton mills of Switzerland have remained almost stationary for the last ten years. Only in special lines of cotton manufacturing, such as the embroidery business, has there been any progress, and the advance in this direction has been of great help in enabling the mills to survive by furnishing an outlet for Swiss cloth and yarn.

The Swiss cotton mill men have had to face higher and higher tariff walls in neighboring countries and also a much keener competition due to these countries rapidly enlarging their factories. The Swiss markets for yarn and cloth lie mainly among their neighbors in Europe, so the result of the advancing industrialism of their former customers has been to cut off their orders on all coarser grades and drive the Swiss mills to finer and finer goods. In their home market they have to compete with the inroads of the Italian coarse counts and the English fine counts, to which is added, in times of depression, sporadic imports of German, Belgian, and French goods, which are dumped into Switzerland as the nearest market at what the Swiss refer to as "bankrupt prices." The Swiss tariff was raised in 1905 especially to enable them to control their home market against being used as a dumping ground.

DISADVANTAGES UNDER WHICH SWISS MILLS ARE OPERATED.

The Swiss mills have to import all their coal and cotton and most of their machinery, and a great number of the mills are located in isolated places where water power was available and where country help could be obtained cheaply. This has proved quite a drawback, for the unfavorable location has made it hard to keep help, and some mills are put to a good deal of extra expense for hauling. There is a dearth of local help, and the mills are driven more and more to the employment of Italians and Germans. The increase of the embroidery business, while of advantage, in affording an increased home outlet, has accentuated the labor difficulty of the mills by enticing away their best workmen. Many also go into the silk business. When the silk and embroidery lines are slack the cotton mills have an abundance of help, but at other times they have to stand a constant drain which they only make good by the employment of Italians. The Swiss still have very cheap labor, but on coarse goods the Italians have the advantage, because their labor is 10 per cent cheaper, and their mills can run at night, while on fine goods the English have the advantage because of the greater efficiency of their operatives, which more than compensates for the higher wages paid.

There are no Government statistics as to cotton manufacturing in Switzerland, for the reason that the control of the country is so decentralized there is no power delegated by the people for such a purpose. The Government is authorized to employ factory inspectors to see that the Confederacy laws in regard to factory operation are carried out, and these, in their occasional reports, give the number of male and female operatives, the number of accidents, etc., but any statistics in regard to the extent of the industry can only be obtained from outside sources.

SPINDLES, LOOMS, AND MILLS.

The president of the Swiss cotton manufacturers association (the Schweizerischer Spinner-, Zwirmer-, und Weber-Verein) gives the following as the number of spinning and twister spindles in Switzerland on January 1, 1907, with a partial list of the number of looms.

Canton.	Spindles.	Twister spindles.	Looms	Canton.	Spindles.	Twister spindles.	Looms.
Zurich	631,818	30,382	8,197	Solothurn	30,244		102
St. Gall	275,228	15,492	3,057	Thurgau	13,492		1,474
Glarus	200,642		3,909	Luzern	12,000		
Aargau	92,170	8,022	706	Schaffhausen		3,400	
Zug	87,992			Appenzell			166
Schwys	50,140		831				
Bern	50,000		400	Total	1,174,026	57,296	18,842

Of the looms 2,096 were given as being on colored goods, and 602 were Jacquard looms. The great bulk of the spindles are mule spindles. The number of looms stated is only partial, due to the fact that some weave mills are independent of the association.

The figures for January 1, 1908, from the same authority, show 1,499,170 spinning spindles, with 9,900 operatives; 117,782 doubling spindles, with 2,342 operatives, and 22,709 looms, with 13,854 operatives.

The cotton mills are entirely in the northeastern section of Switzerland, mainly in the cantons of Zurich, St. Gall and Glarus. The city of Zurich is the largest and most important commercial center of Switzerland, and the cotton manufacturing industry (outside of the special line of embroidery which centers at St. Gall) has its headquarters at that point. There are few mills at Zurich, but the larger mills have their offices there, most of the banking and export business is carried on at that city, and the manufacturers association has its office there.

SIZE OF FACTORIES AND COST OF OPERATING.

There are cotton mills at Winterthur, Wald, Flums, Baar, Wetziken, Mels, etc., but the mills are so scattered that none of these places can be claimed as big cotton mill centers and, in fact, Switzerland has no great mill center, as each owner has tried, it would seem, to locate his mill as far away from any other mill as the small limits of the district would permit. Most of the mills are small, the average being 22,000 spindles or 300 looms. There are four yarn mills containing over 50,000 spindles, the largest one being at Zurich, and containing 179,520 spindles, one at Flums with 100,000 spindles, one

at Baar with 58,068 spindles, and one at Langenthal with 50,000 spindles. The weave mills with over 300 looms are nine in number, which contain from 500 to 840 looms.

About 50 per cent of the cotton mills are operated by water power, 40 per cent by steam, and 10 per cent by electric or other motive power. The new mills are mostly steam or electric, and those that utilize water power have it electrically transmitted, and no longer locate at the fall, as was necessary with the old mills. A manager of one of the water-driven mills told me that while his motive power was cheaper than that of the steam-driven mills, in regard to direct operation, the difference was small, and that if the interest be figured on what they had had to pay for buying up water rights, to prevent the stream being diverted for other purposes, as well as the costs of canal and flume and upkeep, his power was actually costing him more than that paid by the steam-power mills. The majority of the Swiss mills are one or two story buildings, of brick or stone, with sawtooth roofs. The steam-heating pipes are usually fastened to the wall about a foot above the floor, and are made with projecting flanges every couple of inches, so as to give the greatest amount of radiating surface.

The complete cost of a spinning mill is given by the president of the spinners' association at about 80 francs ($15.44) a spindle. Most of the textile machinery is imported from England, especially the spinning machinery, though a good deal of weaving machinery is made in Switzerland, and some machinery, mainly dyeing and finishing, comes from Germany. There is an import duty of 77.2 cents per 220 pounds on textile machinery. All of the embroidery machinery is made in Switzerland. Looms made in Zurich are not only operated in Switzerland, but are largely used in Italy, and some exported to other countries. All coal used in Switzerland has to be imported and the present (January 1, 1908) price of German coal landed at Zurich is 34.3 francs ($6.62) a ton.

FACTORY LAWS AND MILL EMPLOYEES.

In regard to legal restrictions, children under 14 years of age can not work in the mills. The weekly hours of labor in the mills are 64, 11 hours for five days and 9 hours Saturday. The usual hours for mills working this time are from 6 to 11.30, and from 1 to 6.30. There is a continuous campaign waged by the workers for shorter hours, however, and most of the mills do not now run over 10 hours, some only 9, and the prospect is for still shorter hours.

One interesting feature of the Swiss laws is that no factory is allowed to work at night, and by night is meant from 8 p. m. to 6 a. m. For any overtime a permit has to be obtained from the local authorities, and only in very rare cases, such as the partial loss of the factory by fire, is a mill allowed to run up to 12 o'clock at night, and then only with extra help; in no case is all-night work allowed. Italy, for this reason, has heretofore been able to displace Switzerland in certain lines, because of the cheapened cost due to night and day work, but under the new Italian law women and children can not work at night, and as the Italian mills are operated mainly by women and children this practically has the same effect as the Swiss prohibition.

The Swiss laws are very particular in regard to precautions against accidents, and it is interesting to note that a report made by the government inspectors in 1906 shows that cotton manufacturing is the safest industry in Switzerland, for, with the largest number of establishments and much the largest number of operatives, it yet furnished less than 1 per cent of the accidents. The percentage of accidents in the various industries according to the report was as follows:

Industries.	Per cent.	Industries.	Per cent.
Metals and machines	29.20	Paper making	3.44
Woodworking	15.77	Work in brass, etc	1.54
Cement, bricks	14.98	Textile industry	.97
Food, stimulants	14.96		
Clocks, jewelry	10.45	Total	100.00
Chemical industry	8.69		

IMPORTING FOREIGN WORKERS.

A government report in 1902 (the latest) gave the number of workers in the cotton manufacturing industry in Switzerland as 49,023, of which 8,392, or 17.1 per cent, were children from 14 to 18 years of age; 22,880, or 46.7 per cent, women, and 17,751, or 36.2 per cent, men. The proportion of women and children tends to increase, due to the sharp world competition making it imperative to keep down costs which are rising with higher price of materials and higher wage tariffs. Of the help brought in from Italy the majority are girls. The proportion of foreign help is becoming larger every year. Of the 49,023 workers in 1902, 44,886 were Swiss, 1,673 were Italians, 1,547 Germans, 874 Austrians, and 43 other nationalities. This 8.85 per cent of foreign operatives has since largely increased, and about an eighth of the hands are now from other countries. Italians are used throughout Switzerland for the cheaper jobs, such as road making, etc., and since, as a rule, the wages are lower in Italy than in the other surrounding countries, most of the foreign operatives are Italians; but the increasing demand for operatives in Italy itself will in time cut off this source of cheap labor. The Swiss are patient, industrious workers, and however small their wages they always contrive to have an account at the savings bank. In the country their diet seems to be coffee, bread, and potatoes three times a day, with meat and wine on Sundays.

Formerly there was a great deal of hand-loom weaving in Switzerland, but this is now a thing of the past. In the embroidery business around St. Gall there is quite a large house industry, but even there the hand embroidery machines are being displaced by machines operated by electricity furnished by lines from the power companies. Hand looms are now to be met with only in isolated homes.

The largest cotton manufacturing company in Switzerland has its office in Zurich, but the mill is located at the small village of Windisch, some 20 miles north of Zurich. This mill has 179,520 spindles, and just at present is doing a good business, but it is significant of the fight of Swiss manufacturers against adverse conditions that in 1900 this mill had 246,692 spindles, and that as spinning frames have worn out they have not been replaced.

WAGES AND HOUSING OPERATIVES.

The hours of labor in this mill are eleven per day (with nine on Saturday), viz, from 6 to 12, and 1.30 to 6.30. When overtime is imperative a permit of the local authorities has to be obtained, and the operatives are paid one-third extra. There is never any night work, as that is forbidden by law. The average daily wages paid by this mill, as furnished me from the books, are as follows:

Operatives.	Wages.	Operatives.	Wages.	Operatives.	Wages.
Weavers	$1.06	On fly frames	$0.62	On reels	$0.55
Picker hands	.74	Mule spinners	.85	Outside laborers	.77
On cards	.58	Ring spinners	.55	Wood workers	.97
On draw frames	.62	Twisters	.51	Iron workers	1.06
On combers	.62	On gassing frames	.64		

On account of the scarcity of Swiss workers, this mill, in common with most others, has had to employ Italian help. They now have 125 Italian girls, and for lodging them the mill has built a special home, which cost $24,125. The girls are lodged in large rooms, each accommodating a dozen or more, and there are bathrooms, a sick room, and a large garden attached. The home is looked after by six Catholic nuns, who are paid by the firm. Each girl pays 90 centimes (17.4 cents) a day for food, lodging, light, etc. The mills as a rule have little trouble in getting help from Italy, and very often a mill simply notifies the local priest of the number of new hands needed, and he notifies his fellow-clergyman in Italy, who informs his flock, and the required number are shortly on hand.

Besides the special large tenement house for Italian girls, this firm has about 100 dwelling houses, each composed of one living room, two or three small rooms, kitchen, and cellar, with 3,240 square feet of land for gardening. The rent varies according to location, size of rooms, etc., from $15 to $35 a year. The manager stated that in the neighboring villages the usual rents for similar dwellings are $48 to $58. The mill furnishes operatives with pure milk at 3⅔ cents a quart, the outside price being 4.3 cents. The firm is now building a house where bathrooms, kitchen for cooking and warming up, reading room, and dining room will be provided for the use of the operatives. There are now two kindergartens managed by the firm, for which the workpeople pay 4 cents per baby per month. The operatives have their own society for cases of sickness, and they also have a cooperative store where they buy provisions, and from which they receive at the end of the year a dividend of all profits made above cost and expenses, which usually runs about 15 per cent a year.

WAGES AND PRICES OF THE NECESSARIES OF LIFE.

An Austrian manufacturer who has made an investigation of Swiss cotton manufacturing gives me the following tables as the actual average daily wages and cost of food at four mills in different parts of Switzerland in the first part of 1907, reduced to American currency. The first table covers the wages:

Operatives.	Mills.			
	No. 1.	No. 2.	No. 3.	No. 4.
Blow room:				
Head man			$1.06	$0.74
Workman	$0.65	$0.59	.60	.53
Waste man	.61	.55	.56	.56
Cards:				
Head man	1.42	.85	1.16	1.12
Card grinder	.77	.67	.62	.66
Can boys	.61	.51	.59	.51
Lap carrier	.60	.51	.54	.53
Oiler				.42
Draw-frame girls	.48	.43	.41	.40
Speeders:				
Head man	1.22	.85	1.03	1.10
Oiler	.61		.64	.49
Speeder hands	.65	.50	.45	.55
Creelers			.35	.39
Ring spinning:				
Head man	1.14	1.07	.87	1.16
Oiler	.61	.61	.67	.44
Spinner	.56	.31	.43	.13
Doffer			.31	.33
Mules:				
Head man	1.27	1.15	.91	1.14
Oiler	.61	.61	.68	.47
Spinner	.91	.78	.65	.79
Piecer	.66	.51	.44	.53
Roving carriers	.53	.32	.37	.38
Reeling:				
Head man	.71		1.06	
Reelers	.56	.41	.43	.45
Packers	.77	.65	.63	.74
Women bundlers	.47	.42	.48	.44
Machine shop:				
Head man	1.62	1.22	1.72	
Machinist	1.12	.73	.91	.99
Wood worker	1.12		1.09	.74
Smith	1.02		1.16	
Carpenter shop:				
Cabinetmaker	1.02	.69	1.01	1.02
Carpenter	.97		.87	.83
Turbine minder	.85			.74
Fireman	.85	.71	.85	.85
Transmission tender	.85	.63	.66	
Night watchman	.81	.71	.63	.63
Porter			.46	
Repair department:				
Head man	.91	.91	1.17	
Repairer	.73	.50	.65	.59
Mason	.97	.73	.70	.76
Average per day	.63	.50	.47	.51

It will be noticed that some of the mills show no doffers. In a good many cases none are employed, but each three spinners work together and doff their frames themselves.

The prices of the necessaries of life for the operatives in the four mills were as follows:

Article.	Mills.			
	No. 1.	No. 2.	No. 3.	No. 4.
	Cents.	*Cents.*	*Cents.*	*Cents.*
Bread, average quality ... 2.2 pounds	6.9	6.5	5.8	6.5
Meat ... do	34.5	32.5	28.8	31.5
Flour ... do	9.7	7.7	9.5	9.5
Potatoes ... do	1.6	1.6	2.0	2.0
Sugar ... do	10.6	17.8	10.6	13.4
Coffee ... do	44.4	62.9	42.6	34.7
Salt ... do	2.8	4.1	2.0	2.2
Milk ... quart	3.9	4.1	3.7	3.9
Kerosene ... do	3.5	8.5	4.1	4.2
Beer ... do	7.7	6.3	5.7	6.7
Cheese ... 1 portion		4.1		

SWISS CONTROL THEIR HOME MARKET BY A TARIFF.

The Swiss cotton industry is an old one and Switzerland was one of the first countries to take advantage of the English inventions in the early development of cotton manufacturing. The number of spindles steadily increased until 1875, when the mills began to feel the restrictions placed upon their export business by the tariffs of other countries. This was the high-water mark, and the industry began to decline and the spindles to dwindle until, in 1905, the spinners succeeded in getting a "fighting tariff" applied to this industry to check the inroads of foreign cotton manufactures. This has given the mills more control over their home market, and with the demand that has sprung up for cloth and yarn for the embroidery business, they have once more begun to slowly increase their capacity. The Swiss spindles now number about 1,500,000.

Swiss cotton mills now stand in the front rank in the production of fine yarns and cloth and in some lines their only competitor is Great Britain. There is a good business in medium numbers, but, since the Italian and other markets have been lost to them, there is very little manufacture of coarse counts. In spite of the fact that the fine counts of the Swiss make the cost of the raw material a smaller factor in the total cost of the finished article, the price of raw cotton determines, in great measure, the profit or loss in the business. The great fluctuations in the price of the raw material, and the changeability of the market for finished goods, as regards price and quality, was such from 1900 to 1905 that the mills were, on the whole, not very successful. Since 1905 the business has been better.

THE FEELING AGAINST COMBINATION.

In 1905 the Swiss spinners were pleased because the English yarn producers were so taken up with the Chinese and Indian markets as to leave the Continent free. In the last days of 1904 the majority of the spinners united to form a syndicate to fix minimum prices for yarn, and so stop the ruinous losses they were suffering. This was beneficial and resulted in some prosperity to the trade, but only lasted as long as the stress continued. This tended to do away with the spirit of individual liberty that is usually so strongly manifest. The "Canton" spirit, that is so strong in Switzerland, does not tend to unity among the mills, even where their interests are identical, and where modern economical development makes it necessary for interests to work together for the common good. The industry has approached a condition where it is not possible to increase the output to compensate for the increased cost, due to rising wages and the lowering of the number of hours, and the only solution is to limit the managing costs by combinations, but the mills are too independent for any general agreement.

The yarn exports continued to drop back during 1905, and Austrian demand for fine yarns began to decline under the new tariff, which levies 38 kronen ($7.71) instead of 33.3 kronen ($6.76) and 28.5 kronen ($5.78) (on Nos. 50 to 60 and above No. 60, respectively), on Nos. 50 to 70, and for Nos. 70 to 80 as much as 43 kronen ($8.73) against the former 28.5 kronen ($5.78). This caused an increase of

fine spinning in Austria. Germany reduced the tariff on coarse yarns, but not on fine yarns, as they were afraid of Swiss competition in the latter. The French tariff practically shuts out Swiss yarns. Owing to the representations of the spinners, the Swiss Government in 1906 raised the tariff on yarns, which was an aid to the home mills, but owing to the embroidery demands for cloth and yarn, it did not stop the import.

There was a strong demand for broad muslins 120 to 140 centimeters (47.2 to 55 inches wide), and contracts were made up into 1907. This demand resulted in the establishment of several new weaving establishments and in old mills being changed from narrow to broad goods. In the regular muslin weaves of 70 to 80 yarns, in widths under 100 centimeters (39.37 inches) there was also a good profit and, consequently, looms on medium calicoes were changed to these articles.

PROSPERITY DURING PAST TWO YEARS.

In 1906 the business was unexpectedly prosperous, and as the whole world seemed to need goods the export business revived. Owing to the fact that so many looms had been changed from calicoes to muslins, the calico yarns were slack the first part of the year, but a demand for calico springing up, prices rose rapidly. In No. 38s, for instance, the price in January was 2.35 francs a kilo (45.3 cents per 2.2 pounds), but in December it was 3 francs a kilo (57.9 cents). The strike that broke out in some spinning establishments at Mulhausen aided in increasing the price of yarn, but the strike did not last long. There were continued labor difficulties, and costs of operation increased. Production, which had increased through the addition of new machines, was brought back to the old point by the successful agitation for shorter hours. The great increase in the embroidery business helped the mills on fine spinning and weaving, and there was a great demand for Nos. 60 to 80, and for No. 120s throughout the year. A brisk demand for ply yarns resulted, which the twisters could not satisfy, resulting in large purchases of yarn, extending up into 1908. The embroidery mills are more and more using 40s, 3 ply, instead of 60s, 2 ply, so that there was also a good business done by the medium count mills. This change has resulted in many spinning mills having to change very considerably the counts they spin, which involves some outlay.

During 1907 the industry as a whole, following the lead of embroidery, was very prosperous, but the money crisis in the United States affected all branches of the industry adversely. For the year, as a whole, the mills made goods profits, and not only the fine weaving but flannels, drills, blouses, betilles, and other lines paid well.

The Swiss spinners do not have any uniform selling agreement, such as is the case in Italy and other countries, for the reason that the mills are hard to get into line on any question. The Spinners and Weavers' Association, almost since its inception in 1878, has tried to obtain some uniform agreement on this subject, but could never get a majority of the mills to sign. The conditions they have sought to obtain are: (1) Conditions of payment to be 4 per cent discount and one month bank remittance, or 3 per cent discount and 3 months bank remittance; interest on current accounts of 5 per cent; (2)

shipment of yarn free to the nearest railway station to the receiver; (3) return of empty cases; (4) rate of exchange to be mean between letter and money on the day of arrival of the remittance.

IMPORTS OF RAW COTTON—EXPORTS OF COTTON GOODS.

About 40 per cent of the cotton used in Switzerland is Egyptian, the remainder being American, with a small quantity of Indian. In proportion to its number of spindles no other country uses anything like as much Egyptian cotton as Switzerland. The following table shows the import of cottons for the years given:

Kind.	1896.	1900.	1906.
	Pounds.	*Pounds.*	*Pounds.*
American	28,761,318	28,299,138	30,111,268
Egyptian	21,880,871	22,279,354	19,766,133
Indian	2,011,370	372,476	2,271,222
Other	505,508	154,500	221,502
Total	53,159,157	51,105,468	52,370,125
Reexports	1,658,130	2,624,080	1,128,007
Net imports	51,501,027	48,481,388	51,242,118

The Swiss exports of yarns and cloth have been declining, so that, in spite of the great increase in the export of embroideries, the total export of cotton manufactures was less in 1906 than in 1900, viz, 35,782,822 pounds and 36,681,833 pounds, respectively. The total exports of cotton manufactures from Switzerland to the several countries, in 1906, were as follows:

Description.	Exported to—					
	United States.	United Kingdom.	Germany.	Asia.	Mexico and Central and South America.	France.
Yarns, single, gray	$40,916	$1,351	$1,444,026	----------	$48,443	$74,305
Other yarns	21,403	17,949	92,640	$713,907	13,510	38,986
Total of yarns	62,319	19,300	1,536,666	713,907	61,953	113,291
Piece goods:						
Gray	54,812	16,984	712,363	4,439	7,141	60,088
Bleached	266,147	146,101	274,832	50,952	94,763	38,000
Dyed	35,126	106,729	145,715	252,251	226,196	113,201
Printed	----------	4,825	7,913	684,957	54,040	18,335
Of dyed yarn	2,702	2,702	20,265	335,820	129,117	19,493
Total of piece goods	358,787	277,341	1,161,088	1,328,419	511,257	250,707
Embroideries	13,475,646	5,474,050	1,872,486	318,836	1,650,343	1,516,594
Laces	965	1,737	10,036	386	772	1,737
Made-up goods	3,281	11,966	28,178	6,369	101,325	28,757
Other goods	794,967	545,032	298,378	335,048	167,331	44,776
Grand total	14,695,965	6,329,435	4,906,832	2,702,965	2,492,981	1,955,862

Description.	Exported to—Continued.				Grand total.
	Austria-Hungary.	Italy.	Balkan States.	All other countries.	
Yarns, single, gray	$227,354	$16,598	$386	$57,900	$1,911,279
Other yarns	208,247	94,184	43,425	127,786	1,372,037
Total of yarns	435,601	110,782	43,811	185,686	3,283,316
Piece goods:					
Gray	98,816	42,653	20,458	48,057	1,066,711
Bleached	98,430	83,955	86,271	188,368	1,328,419
Dyed	71,410	115,028	50,759	258,620	1,375,125
Printed	46,899	93,605	308,028	150,347	1,368,949
Of dyed yarn	3,088	4,053	210,370	203,808	931,418
Total of piece goods	318,643	339,294	675,886	849,200	6,070,622
Embroideries	506,625	603,125	210,177	3,138,373	28,766,264
Laces	11,966	38,600	2,702	5,983	74,884
Made-up goods	6,176	18,721	6,918	26,634	238,355
Other goods	54,619	46,899	32,617	250,707	2,570,374
Grand total	1,333,630	1,157,421	972,191	4,456,583	41,003,815

SWITZERLAND'S BEST CUSTOMERS—IMPORTS OF COTTON GOODS.

It is seen that the best customers for Swiss embroidery are the United States and the United Kingdom, while for cotton-mill products the best markets are those nearest to Switzerland. The best yarn market is Germany, while gray goods go to Germany, Austria, and France, and bleached goods to Germany, America, and England. Of the smaller amounts of other cloths the solid dyed goods go to Asia, South America, and Germany; colored goods to Asia, the Balkans, and South America, and printed goods to Asia and the Balkan States.

Swiss exports in embroideries are increasing rapidly, and the trade in embroidery cloths and fine bleached cloths is also increasing, but in most other lines the cotton exports have been declining, especially in yarns. On the other hand the imports of cotton goods into Switzerland have been on the increase, due mainly to the expansion of the embroidery business. This condition of affairs is clearly shown by the following table, contrasting the exports and imports of cotton manufactures in 1900 and 1906:

Description.	Imports.		Exports.	
	1900.	1906.	1900.	1906.
Single yarns, gray	$263,036	$1,138,932	$2,605,720	$1,911,279
Other yarns	1,514,403	1,154,867	1,199,440	1,372,037
Cloth:				
Gray	3,324,720	5,073,391	1,421,049	1,066,711
Bleached	134,663	222,915	352,151	1,328,419
Dyed	426,839	361,875	756,932	1,375,125
Printed	409,361	562,981	1,511,506	1,368,949
Of dyed yarn	90,467	394,492	1,276,354	931,418
Embroideries	115,149	253,332	21,339,385	28,766,264
Laces	151,235	271,312	62,771	74,884
Made-up goods	639,332	2,126,637	71,279	238,355
Others	2,965,960	3,693,879	1,871,294	2,570,374
Totals	10,038,195	15,254,583	32,527,881	41,003,815

EXPORTS TO THE PHILIPPINES.

The Swiss shipments of cotton manufactures to the Philippines in 1906 amounted to $334,866, and consisted of the following, according to the Swiss returns:

Description.	Pounds.	Value.	Description.	Pounds.	Value.
Yarn, bleached, glazed, or mercerized	23,142	$16,732	Piqués, damasks, brilliantines, etc	$2,645	$2,323
Yarn, dyed or printed	178,083	59,658	Brocades	8,816	7,178
Cloth:			Embroidery	1,763	2,685
Bleached or mercerized	66,120	39,779	Embroidered cloths	14,103	21,388
Colored	150,313	78,914	Other articles of cotton	4,849	3,944
Printed	7,714	4,987			
Of colored yarn	174,557	94,278	Total	632,108	334,866

The main article shipped by the Swiss is the cotton netting called "betilles," used by the Filipino women for shirt waists which are worn plain, embroidered, colored, dyed, etc.

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60TH CONGRESS } HOUSE OF REPRESENTATIVES { DOCUMENT
2d Session } { No. 1330

MANUFACTURE

OF

WOOLEN, WORSTED, AND SHODDY IN FRANCE AND ENGLAND

AND

JUTE IN SCOTLAND

BY

W. A. GRAHAM CLARK
Special Agent of the Department of Commerce and Labor

JANUARY 15, 1909
Referred to the Committee on Interstate and Foreign Commerce
and ordered to be printed

WASHINGTON
GOVERNMENT PRINTING OFFICE
1909

DEPARTMENT OF COMMERCE AND LABOR,
OFFICE OF THE SECRETARY,
Washington, January 15, 1909.

SIR: I have the honor to transmit herewith, in compliance with the act making appropriations for the legislative, executive, and judicial expenses of the Government for the fiscal year ended June 30, 1909, approved May 22, 1908, the report of Special Agent W. A. Graham Clark on the manufacture of woolen, worsted, and shoddy in France and England and jute in Scotland.

Respectfully,

OSCAR S. STRAUS,
Secretary.

The SPEAKER OF THE HOUSE OF REPRESENTATIVES.

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LETTER OF SUBMITTAL.

BRADFORD, ENGLAND,
November 1, 1908.

SIR: I have the honor to submit herewith a report on the manufacture of wool and associated fabrics in England and France, together with a short sketch of the Dundee jute trade. In the case of the English wool trade, I was directed to obtain the costs of manufacture for use by the Ways and Means Committee in their work of revising the tariff. I obtained from Yorkshire manufacturers eighteen samples of goods, ranging from low tweeds (shoddy) costing 35.8 cents a yard up to men's high class worsteds costing $1.42 a yard. There was obtained also complete figures for one shoddy mill and one worsted mill showing first cost of mill, operatives required, wages, and detailed costs of manufacture, including all charges. The samples in all cases are now on file with the Bureau of Manufactures. One English mill in giving four samples covering their range of manufactures told of a mill that made the same goods in the United States. The American mill later furnished their costs, which furnish the basis for an exact comparison.

In general it may be said that the cost of manufacture of worsteds in England is about half that in the United States. They have (1) cheaper first cost of machinery and building, (2) cheaper money, (3) cheaper raw material, (4) cheaper labor, (5) cheaper power and (6) cheaper supplies. Their advantage is greater in having cheaper raw material than in having cheaper labor, as wool represents the largest single element in the total cost.

The export of manufactures of wool from Great Britain in 1907 was $185,600,000. There are no production figures, but it is generally considered in Great Britain that while they export 80 per cent of their cotton production they only export 40 per cent of their wool production. On this basis their total wool production would be $464,000,000. The United States Production Census in 1905 gave the total wool manufactures produced in the United States as $380,934,003. The United States impo ts about 5 per cent of her

manufactured wool requirements. Of a total of $22,357,206 manufactures of wool imported into the United States in 1907, $7,786,398 came from Great Britain, $5,377,054 from Germany, $4,432,850 from France, and $2,922,675 from Turkey. In normal years England supplies a much larger proportion of this total, her share in 1906 being $9,779,496 out of a total of $22,353,591.

The methods of manufacture of wool in French and English mills are different, and it is due to this fact that England excels in the production of worsteds for men's wear, and France in the production of softer goods for women's wear.

Very respectfully, W. A. GRAHAM CLARK,
Special Agent.

To Hon. OSCAR S. STRAUS,
Secretary of Commerce and Labor.

FRENCH WOOLEN INDUSTRY.

EXTENT OF WOOLEN TRADE.

CONCENTRATION OF MANUFACTURING OPERATIONS AND DIFFICULTIES IN MARKETING THE PRODUCTS.

France is one of the great wool manufacturing countries and is the recognized leader in the manufacture of artistic goods, such as women's dress materials. While, however, the great English wool manufacturing industry is steadily increasing, the United States and Germany rapidly forging ahead and Italy beginning to struggle for a place among the leaders, France is lagging behind and the industry as a whole is almost stationary. This is due both to home and foreign causes. At home the French population is at a standstill, and besides they are of a saving turn of mind, so that the increasing wealth of the masses is not productive of any great increase in consumption. The fact that both coal and textile machinery are largely imported makes the first cost, and also the operating cost, of the mills higher than that of their neighbors, such as Belgium and Italy. Legal restrictions are numerous, and in at least Belgium, Italy, and Germany longer hours are permissible. Abroad many former customers are beginning to manufacture their own requirements.

POSITION OF THE INDUSTRY.

At the present time the French manufacturers of wool and worsted ship over half of their exports to England alone and of their main export in this line, clothing stuffs, over three-fourths go to that country. The French exporter therefore has all his eggs in one basket, and though the high artistic taste of the French designer enables him to maintain his foothold there in spite of the keen competition of Bradford the slightest fluctuation in that market affects the whole French trade.

What Bradford is in England, Philadelphia in the United States, Verviers in Belgium, Brunn in Austria, Lodz in Russia, and Biella in Italy, such is Roubaix in France. Bradford, Verviers, and Roubaix, or rather Roubaix-Tourcoing, are more especially similar, as the industry in the other countries is more scattered and therefore the head center does not embrace such a large proportion of the total. Roubaix and its twin town Tourcoing are in the Department du Nord,

in northeast France, near Belgium, and this department embraces over half of the spindles and looms and nearly all the combs working on wool in France. The industry belongs to the northeast section of the country—old French Flanders, Picardy, and Normandy—of which the modern departments are called Nord, Somme, Ardennes, Marne, Aisne, Oise, Seine Inferieure, and Eure. Next to Roubaix-Tourcoing the most important towns are Rheims, Fourmies, Cateau, and Elbœuf.

SOUTHERN BRANCHES OF THE INDUSTRY.

Vienne on the Rhone, in the Department of Isere, is the center of the manufacture of what is euphemistically called in France "Renaissance cloth," but which in the blunter English language is called shoddy, though also occasionally disguised as "merino," etc. The Department of the Tarn, a wool manufacturing center in southwestern France, owes its importance to its fellmongering industry. Sheepskins or "fells" are imported from abroad, mainly from the Plata, and are here relieved of their wool by careful soaking and heating without the use of chemicals. Part of these skin wools are used in France and part shipped to England and other countries.

The hand-loom industry centers around Cambrai and St. Quentin, and though declining of recent years, it is still a good-sized industry, and some of the most artistic French work is made on these looms. Formerly Amiens was the center of this industry and the Picardy hand weavers had an inherited skill that enabled them to compete with power looms on all lines where skill and address were needed to meet the sudden demands of ephemeral vogues. Even in the machine industry, however, there are now periods toward the end of each season when the mill workers are idle, and though the hand-loom weavers eked out their living by farm work, these periods of idleness which are more severely felt by their branch of work than by the regular mills, have, together with the demand for "tailor-made" clothes among women, driven them to gain their living in a steadier occupation, so that there is now little or no home weaving left in this section.

In the Cambrai section there are still villages of 300 to 400 home weavers. The business part is carried on through middlemen or "facteurs," who buy the yarn from exporters, with whom they agree as to the kind of goods to be made and fix the price and then make their own terms with the home workers. In the Cambrai-St. Quentin district one thing that has cut down the number of such home weavers of late is the fact that they lie in a section that is dominated by the progressive lace industry. The "entrepreneur de decoupage" or clipping contractor makes his house-to-house round through these villages, offering work at clipping the floats and cutting apart the lace strips, as made on the machines of Caudry and Cambrai, and though the remuneration is small the work is easier and less absorbing than that of hand weaving, besides being much steadier, so that in many cases the shuttle is being laid aside for the scissors.

LABOR AND MACHINERY COSTS.

There are no accurate figures as to the machines and operatives employed in the French wool-working industries. A parliamentary

committee inquiring into the trade in 1904 estimated that there were 1,600 combs, 2,000,000 worsted spindles, 390,000 woolen spindles, and 35,000 looms. The French census for 1901 shows 161,355 active workers in the "Industrie Lainiere." In the latter case at least the figures are too small, as several subordinate branches of the industry are included under "textile industries not specified." It is clear, however, that the worsted branch of the business is much larger than the woolen, and also that the combing branch of the industry is proportionately larger than in the case of most other wool manufacturing countries. The combing mills not only supply their own spinners, but the export of tops (the roving produced by combs) is a large industry in itself. There is an active future market for tops at Roubaix-Tourcoing, and though efforts have been made to abolish this feature (a similar future market for tops at Leipzig was abolished by the German Government at the request of the trade) it has as yet only resulted in stricter legal supervision.

CONCENTRATED ON THE BELGIAN BORDER.

The French wool-working industry being concentrated in the section around Roubaix-Tourcoing, is just on the edge of the Belgian border. It is very close to Tournai, Mouscron, and other Belgian towns interested in wool working, and there seems a strong tendency for part of the industry to gradually move across the border, the operating costs of the Belgian mills in most cases being lower. Land, coal, machinery, and building materials are all cheaper in Belgium, and as living is also cheaper the wages are lower. Taxes are lower in Belgium, and legal restrictions are fewer. Wages in Roubaix-Tourcoing itself would be much higher were it not for the large number of Belgians working in the mills there who have their homes just over the border in Belgium.

Part of the machinery used in the French wool-working industries is made in France, at Roubaix, Lille, Belfort, etc., though the bulk is imported. The old center of the French manufacture of textile machinery was at Mulhausen in Alsace and since its loss no new center has taken its place. The English supply largely the spinning machinery and looms and Mulhausen the mules and combs; Switzerland ships looms, and there is also some machinery from Belgium and other countries. The French manufacturers claim that having thus to import machinery and pay the tariff, freight, etc., their cost per machine laid down is in most cases at least 20 per cent higher than that of the English factories.

COMPARATIVE OPERATING EXPENSES.

The Roubaix manufacturers have yearly to face keener competition from the comparatively young wool-working industries of Germany and Italy. They say that though Germany still buys large quantities of tops, their takings are decreasing, and at the same time they are beginning to reach out for the French markets for tops in Poland, Moravia, and other places. They also say that Italy's competition is increasing fast, especially in the Levant, where the cheap Italian cloths and stuffs, well made and skillfully dyed, are displacing similar French goods, which is due to the fact that the Italian workman is similar in his artistic instincts to the Frenchman, and can live cheaper and *work cheaper*. On this latter point it is apparent that

they are correct. At Biella, in Italy, the writer went through a large woolen mill, and was informed by the management that the ordinary workers averaged only 1½ lire (approximately 30 cents) a day; while on looms 1.65 meters wide, running 75 picks on Jacquard work and 90 picks per minute on plain work, the weavers, running one loom each, were paid 12 to 14 centesimi (100 centesimi=19.3 cents) per 1,000 picks, and that on looms 1 meter wide, making 120 picks per minute, the weavers running two, and occasionally three, looms were only paid 2 to 3 centesimi per 1,000 picks. The Italian wages are so much lower proportionally than the French that in the last two or three years some French manufacturers have begun to organize branch mills in Italy for the spinning of the fine wool articles, which, as heretofore, has been a branch of the trade little developed there.

In the beginning of 1904 the French wool-working industry was in bad shape. It partly recovered in 1904, had a prosperous year in 1905, and in 1906 had one of the most prosperous seasons of its history. This continued until about the middle of 1907; since then it has been much depressed. The spinning and weaving mills in France do not ordinarily run at night, while the combing mills do. The combing mills, however, are the most subject to fluctuations, and frequently the end of the season sees the stoppage of all night work, and in recent years the condition has tended to become chronic to shut down much of the dull season from the latter part of August to the latter part of November. The weaving mills have to change often to catch the popular fancy in stuffs and draperies, for as they do not work on fixed standard articles as much as is done in the cotton trade, they therefore are not able to sell so far ahead, and might almost be described as working only from day to day.

TRADE CONCENTRATION TENDENCIES.

In the following notes I will briefly show where the French manufacturer gets his raw material, what he sells, and to whom, the recent tendency of the import and export trade, and then give a few points from personal observation as to the French factory methods and wages and how they differ from the English and American systems.

Dunkirk is the port for Roubaix-Tourcoing, as is Antwerp for Verviers and the Rhine, and Hamburg for north Germany. These are the three "wool ports" of the Continent. The wool imported at Dunkirk is nearly all in the greasy state. The manufacturers prefer it in this style for, though the freight cost is doubled, the fibers are kept supple on their long journey and do not mat together, as would be the case with close-packed washed wool. Most of the wool, whether from Australia, La Plata, or elsewhere, is "cross-bred," that is, it is clipped from sheep that are a cross of the old Spanish merino breed with its short but fine fleece and the English Leicester or Lincoln, with its longer, coarser fleece. The Rheims mills which have devoted themselves more to the use of the fine merino wool are decreasing, because they have not so readily adapted themselves to the use of the cheaper and more popular cross-bred wool, as have the Roubaix mills. In olden times Sedan was the center of the woolen industry and Rheims of the worsted. The former has almost dropped out of the industry, and Rheims is steadily losing, as are nearly all other French wool-manufacturing towns, to still further concentrate the industry around Roubaix-Tourcoing.

SOURCES OF WOOL SUPPLY.

The figures for the wool in bulk imported into France in 1907, according to the French customs returns, are as follows:

Country	Pounds.	Country.	Pounds.
Argentine Republic	208,106,970	Turkey	9,822,126
Australia	164,656,211	Belgium	3,052,981
England	67,372,553	Other countries	67,550.616
Uruguay	37,645,422		
Algeria	29,810,643	Total	558,017,502

The wool shown as coming from England is mostly Australian, and that from Belgium is mostly from Argentina, so that there is very nearly the same amount contributed by both Australia and Argentina. The manufacturers usually class their wool supply as Australian, La Plata (includes Argentina and Uruguay), common (from Turkey, Algeria, South Africa, etc.), skin wool, and wool from sheep imported for food (laines des moutons importés).

The foregoing figures are for greasy wool, and to show the amount of actual wool consumed by the French factories is difficult. Not only are the figures for the home clip general, but for the reason that the greasy wools imported will yield only from a third to a half of their weight in actual wool, that part of the wools exported is greasy and part washed, that some wool is imported and exported already carded, combed, or dyed, but not spun, and that there also has to be considered in studying the total available for mill use the import and export of pulled and unpulled waste, accurate figures are impossible to obtain from any Government records. A French authority, however, has recently worked up some figures, based on his experience, that are regarded by the trade as the most correct obtainable. He figures that the home clip in the greasy state will yield 39 per cent of wool in the washed state, that Australian will produce 45 per cent, La Plata 44 per cent, the common wools 50 per cent, the skin wools 38 per cent, and wool from imported sheep 35 per cent; also that allowing for the proportion of washed wool in the wools exported the total washed wool exported may be figured as 60 per cent of the recorded figures. Obtaining the net imports of pure wool on these suppositions, subtracting the net export of wools carded, combed, and dyed, and also taking into consideration the waste exported and imported and adding the French home clip, he has obtained the following figures as the amount of actual washed wool available and ready for spinning by the French mills for the last ten yearly periods:

Year.	Pounds.	Year.	Pounds.
1898	150,295,000	1903	136,851,000
1899	133,764,000	1904	103,654,000
1900	113,100,000	1905	131,586,000
1901	157,278,000	1906	151,818,000
1902	111,640,000	1907	156,946,000

NET FACTORY CONSUMPTION.

There are some 20,000,000 sheep in France producing about 43,000,000 kilos or 95,000,000 pounds greasy wool annually, and as these fleeces are figured to give a yield of 39 per cent washed wool, this amount produces some 37,000,000 pounds pure wool which would be about 24 per cent of the total estimated. Part of this home clip

is exported, so considering the proportion of the different wools the actual French factory consumption is estimated to be made up about as follows: Australian 30 per cent, La Plata 30 per cent, common (Turkish, Algerian, etc.) 10 per cent, skin wool 9½ per cent, wool from imported sheep one-half of 1 per cent, and French home clip 20 per cent.

The French industry in 1907 as shown above used some 155,946,000 pounds pure wool, and there was exported 19,003,322 pounds of yarn more than was imported, so that the amount of wool actually turned into goods must have been about 137,000,000 pounds. The export of woolen and worsted goods that were listed as being of French origin was 57,399,213 pounds, which would show that of the total production of the French mills 40 per cent was exported and 60 per cent consumed at home. This seems a large proportionate export, but the French wool manufacturing industry, like the English, is largely organized on an export basis, and it is probable that in normal years the proportion exported will range between 30 and 40 per cent or more.

STATISTICS OF FOREIGN TRADE.

The French exports and imports of wool and its manufactures in the calendar year 1907 were as follows:

	Imported.		Exported.	
	Pounds.	Value.	Pounds.	Value.
Wool, in bulk	588,017,502	$106,072,607	112,318,705	$25,682,317
Wool, in bulk, dyed	28,652	12,159	65,018	30,108
Wool, combed or carded	2,465,174	145,522	47,689,711	21,759,592
Wool, combed or carded, dyed	73,173	37,249	564,444	311,309
Total wool	590,584,501	106,267,537	160,637,878	47,783,326
Yarn, single:				
Bleached or not, combed	560,918	94,184	13,116,224	7,078,854
Bleached or not, carded	983,425	473,622	738,342	261,901
Dyed or printed, combed	36,807	24,511	1,975,225	1,134,647
Dyed or printed, carded	251,697	135,486	121,000	47,671
Yarn, twisted, for weaving:				
Bleached or not, combed	1,654,534	933,348	4,156,523	2,564,391
Bleached or not, carded	17,852	9,264	154,941	59,830
Dyed or printed, combed	325,310	184,894	2,278,064	1,403,496
Dyed or printed, carded	29,533	17,370	163,537	67,550
Yarn, twisted, for tapestry:				
Bleached or not	2,424	1,158	14,767	8,685
Dyed	21,819	11,966	169,047	108,045
Total yarn	3,884,328	1,885,803	22,887,660	12,735,070
Clothing stuffs of pure wool:				
Merinos	.....	.....	2,413,380	1,357,948
Muslin	153,178	158,646	19,615	8,299
Other	1,762,980	1,031,971	30,079,531	21,422,614
Cashmere and other cloths	9,345,180	5,206,754	17,331,595	13,245,204
Knit goods	577,889	370,753	3,665,031	1,406,619
Blankets	127,171	6,755	2,823,103	1,180,195
Carpets, pure and mixed	1,127,400	541,172	1,390,000	667,008
Pure wool furnitures	341,840	1,158	944,634	597,528
Trimmings and ribbons, pure	19,836	13,124	343,163	460,884
Trimmings and ribbons, mixed	11,681	14,475	316,935	418,424
Tapestry	4,408	23,160	43,198	272,130
List shoes	123,424	54,040	539,319	200,913
Shawls	441	193	53,998	79,709
Furniture velvets	16,530	6,562	36,145	21,809
List cloth	17,411	1,351	126,289	9,457
Laces and guipures	5,069	6,755	2,645	4,246
Fezzes and red caps	1,970	579	18,335	3,667
Moire	604,557	348,365	36,807	193
Lastings	4,628	5,211	.....	.....
Embroidery, hand and machine	881	5,211	.....	.....
Mixed stuffs	1,350,391	590,966	4,512,249	4,529,710
Total stuffs, etc	15,596,865	8,387,201	64,695,972	45,885,557
Total manufactures of wool	.....	10,273,004	.....	58,620,627

The import and export of other woolen articles were as follows:

	Imported.		Exported.	
	Pounds.	Value.	Pounds.	Value.
Wool waste	28,710,847	$7,449,800	43,204,130	$7,916,281
Felt hats of wool	*Number.* 451,400	51,531	*Number.* 760,600	158,453

The exports of manufactures of wool are seen to be (1) clothing stuffs (worsteds); (2) cashmere and other cloths; (3) yarn (mainly combed); (4) knit goods; (5) blankets; (6) carpets; (7) pure wool stuffs for furnitures, and (8) trimmings and ribbons, besides a large amount of mixed stuffs.

COUNTRIES PURCHASING FRENCH WOOLENS.

Of the pure wool stuffs for clothing, Great Britain takes three-fourths (24,575,702 pounds in 1907 out of 32,512,526 pounds) and the remainder goes mostly to Belgium, Japan, and United States. Of the cashmere and other cloths exported, Great Britain and the United States each take a sixth (2,971,433 and 2,387,593 pounds, respectively, out of a total of 17,331,595 pounds) and the remainder goes to Italy, Belgium, Spain, Switzerland, Algeria, Chile, Argentina, Germany, Brazil, and Turkey. The great bulk of the yarn exported is the combed yarn and it is bought by Great Britain, Belgium, and Germany. One-half of the knit goods go to Great Britain and the remainder to Belgium, Switzerland, and Italy. The blankets go to Egypt, China, Belgium, and Algeria; the carpets to Great Britain, United States, and Belgium; the pure wool stuffs for furnitures to Great Britain and Italy, and the passementerie mainly to Great Britain, with some to Spain, United States, and Switzerland. Fezzes go to Senegal and West Africa; shawls to Colombia and Mexico, and mixed goods to Great Britain, Italy, and Belgium.

French possessions and colonies are a very important market for the French cotton manufacturer, as they take a fourth to a fifth of his total export, but they are of slight interest to the French wool manufacturer, as their takings in this line account for but 3 per cent of his total sales abroad.

In the export list the predominance of the takings by Great Britain is very noticeable. The French statistics of woolen and worsted tissues exported in 1907 record the takings of the main countries as follows:

Country.	Value.	Country.	Value.
Great Britain	$23,700,593	Argentine Republic	$852,674
Belgium	3,853,631	Brazil	554,875
United States	3,543,287	Spain	465,709
Algeria	1,158,772	Austria-Hungary	252,058
Germany	1,153,368	Russia	71,989
Turkey	1,098,556	Others	7,009,397
Italy	1,065,553		
Switzerland	1,045,095	Total	45,885,557

COMPARISON AS TO IMPORTS AND EXPORTS.

The export figures for the last ten years show increasing exports of yarn, but as the exports of stuffs. cloths, etc., also of tops, have

been almost stationary, this may then be taken as a sign of the increasing manufacturing ability of their neighbors, especially Great Britain, Germany, and Italy, rather than of their own. The increasing export of yarns from France and the unprogressive state of the country's export of woolens and worsteds is shown by the following table, expressed in millions of dollars, for the last ten yearly periods:

	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.
Yarn	6.69	7.15	6.67	4.67	6.62	6.81	5.96	8.00	10.29	12.83
Tissues	43.01	50.95	43.85	41.22	42.51	42.14	40.86	37.33	43.22	45.89
Total	49.70	58.10	50.52	45.89	49.13	48.95	46.82	45.33	53.51	58.62

The importation into France of yarn and tissues of wool during the same periods, in millions of dollars, was as follows:

	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.
Yarn	1.93	1.91	1.51	1.33	1.71	1.83	1.55	1.71	2.20	1.88
Tissues	7.40	7.86	8.10	7.24	8.31	7.98	6.91	7.49	8.07	8.39
Total	9.33	9.77	9.61	8.57	10.02	9.81	8.46	9.20	10.27	10.27

The yarn imported was about three-fourths carded and consisted of coarse singles (10,000 to 15,000 meters per kilo) and fine ply-yarns (40,000 to 50,000 meters per kilo), the great bulk being of the latter. The majority came from Belgium. Of the tissues imported the largest amount was men's worsteds and came from England. Switzerland seemed to be the only nation that could ship into France women's dress materials in competition with the standard home articles, though Germany competed on some of the cheaper grades. There was also a considerable import of carpets from Turkey. The import of tops was small and principally only those made of the brilliant or lustrous wools that are a monopoly of England.

The French export of goods include the finest made and also some of the shoddiest, though in both cases they are beautifully dyed and finished. The mixed goods are mostly of cotton and wool, with quite a little of fancy goods made with silk and wool, in many cases the stronger fibers being used for the purpose of wrapping around with the weaker grades of worsted threads on the twister.

The French manufacturers are at no loss for conditioning houses in which to store and test their yarns, tops, etc., for besides the large "Conditions publiques," at Tourcoing, Roubaix, and Mazamet, there are other conditioning houses for wools at Fourmies, Cateau, Amiens, Lyon, and Paris.

MANUFACTURING OPERATIONS.

TECHNICAL PROCESSES FOLLOWED DIFFER WIDELY FROM THOSE IN OTHER EUROPEAN COUNTRIES AND UNITED STATES.

To show the difference between the French and the English or American processes in the manipulation of the wool in making worsted yarn it is necessary to roughly sketch the difference between the main kinds of yarn made of wool—the woolen yarn, the worsted yarn of short wools, and the worsted yarns of long wools.

Both woolen and worsted yarns are, of course, made of wool, the main difference being that the former is put through as few processes as possible—usually only carding and mule spinning—so that the yarn more resembles the original material, with short unparalleled fibers projecting in all directions; while the worsted yarns go through more processes and the long fibers only are retained and these are paralleled and smoothed out straight. The woolen cloth from the first has usually a fuzzy appearance and this is in many cases increased by napping, especially for blankets, so as to entirely hide the structure of the cloth. Worsteds are usually not napped at all or only slightly as it is important to show the design.

CARE OF THE WOOL.

For both classes the wool as it comes from the sheep is sorted and then washed to remove the natural grease, perspiration, and dirt which, together, make up one-half to two-thirds of its gross weight. It is usually shaken in a machine called a willey to remove the loose dirt before undergoing this process. After washing there still remain burrs and other extraneous matters embedded in the fibers. In olden times these were removed by hand or by a rough burring machine consisting of wire-covered beaters. Then a process of carbonization with acids was introduced by which the vegetable matters were burned out. If not very carefully done this deprives the wool of its "nature" and renders it brittle and hard to work up into manufactures where "live wool" is required. There have therefore been new inventions to do away with the sulphuric acid bath and to use only mechanical means again. One such method known as the "Youla nonchemical system" is increasing in use in France and is much favored by the manufacturers. After being washed, cleaned, and dried wholly or partially, the wool is oiled with olive oil or a cheaper substitute to make it supple and is then ready for manufacture.

For woolen yarn or for worsted yarn from short wool the first process is carding; for worsted yarn from long wool it is "preparing." The woolen and worsted cards are essential in their main work and consist of "sets" of cards (two or three cards arranged together tandem, the first being called the scribbler and the last the carder), each made up of wire-covered cylinders against the upper surfaces of which

operate pairs of small "working" and "stripping" rollers instead of the top flats as used on cotton cards. The take-off arrangement of the woolen and worsted cards are different. In the first the material is stripped from the cylinder by two doffers carrying alternate rings of card clothing and smooth leather, the card clothing rings of one working in the line of the smooth leather rings of the other, so that the two doffers together strip the cylinder completely. These doffers in turn are stripped of their ribbons of wool which pass between broad leather belts which work from side to side with an action like that of the hands and roll each ribbon up into a sliver. These wind up side by side in cheeses on a beam, which then goes to the mule. In the worsted card the web comes off in one sheet and is condensed into a single sliver like that of a cotton card, but instead of winding into a can it is rolled up into flat-ended balls by an automatic balling attachment.

THE CARD NOT USED FOR WORSTED YARNS.

For worsted yarns to be made from long wool, where in some cases the fibers are twelve inches or more in length, the card can not be used on account of the danger of breaking the fiber. The material is "prepared" instead by being passed through six sets of graduated "gill boxes" which are practically draw frames with combs or "fallers" working between the back and front rollers.

The worsted slivers as made by either process are then put through a "backwashing machine" to eliminate the oil and remaining dirt. In this machine they are run through bowls of suds, between squeezing rollers and over drying cans. They are then oiled again and put through two more gill boxes. They then go to the combs which are always steam heated; here the tops are separated from the noils and waste. Only the tops are used in worsted manufacture and the slivers of these, after the combing operation, are again backwashed, put through two gill boxes and rolled up into balls again. This completes the work of making "tops."

These tops are kept as balls for a while in a conditioning chamber so as to preserve the straightness that has been imparted to the fibers and also to bring them to the proper condition. Cotton yarns are supposed to contain 8½ per cent moisture and silk yarns 11 per cent moisture, but worsted yarns to work well should contain between 15 and 16 per cent.

Before spinning the tops are put through drawing processes of gill boxes and roving boxes and wound on bobbins for use in the spinning room.

ESSENTIAL DIFFERENCE BETWEEN ENGLISH AND FRENCH SYSTEM.

The foregoing are the general processes used in making yarns from wool, and we will now notice how the French system differs from the English system. It may be noted that it is largely due to the difference in the mechanical systems employed that England excels in the production of worsteds for men's wear, such as tweeds, coatings, trouserings, etc., while France excels in the production of women's dress materials, especially of soft and nicely draping materials for skirts, etc., and of draperies in general.

The essential difference of the two systems is that the French, besides using the mule where the English use the ring frame in making

worsted yarn, send the material to the mule with scarcely any twist in it at all, while the English send the material to the ring frame with some twist already inserted. In other words, the English worsted ring spindle uses roving and the French mule spindle uses sliver, according to the accepted definition of these terms.

In England the tops, after storing and conditioning, are put through gill boxes and then through roving boxes and wound on the bobbins of vertical spindles by means of flyers. The rotation of the flyer inserts sufficient twist to enable the roving to stand the strain on the ring spinning frame. In the French system the top slivers go through the gill boxes as above, but there are no roving boxes. For them there is substituted a machine, the "bobbinoir," in which the slivers in passing from the back set of rollers to the front are supported by a porcupine cylinder and are then wound onto horizontal bobbins. No twist at all is inserted, except that rubbing leathers like those of a woolen card are employed to give firmness to the slivers to stand the slight strain put on them by the mule.

The worsted sliver in the French system therefore goes to the mule in the same form as the woolen sliver, though, of course, the fibers are longer and more cleaned and paralleled. The difference between the English and the French system is important, and as the French system puts so much less strain on the yarn they can spin relatively short fibers to much higher counts than possible in the other system. The yarns so made are softer and have a different feel from those made on the English plant and give entirely different qualities to the goods made therefrom.

COMBING VARIATIONS—MILL ORGANIZATIONS.

In England also, while the Heilmann comber is largely used for cotton, the Noble comber is ordinarily used for worsteds. In France all makes of combs are employed—the Lister or nip combs (for long wools only), the square motion Holden combs (mainly in factories of the Holden name), the Noble, the Offerman, etc., but the bulk are mainly of the Heilmann type, as this is especially suited for the French work and for short staples. Much of the French combing is also "dry;" that is to say, oil is not used at all to limber up the fibers, or else only in small quantities such as can be entirely washed out of the tops after combing and before the final gilling. The French also have special methods of dyeing and finishing, which are too technical to describe here.

Turning from the mechanical to the commercial side of the business there are still other differences in the French manufacture from the American, noticeably in that they are family businesses, that they individualize the separate processes, and in their system of commission work.

The majority of the mills in the United States are incorporated companies; in England they are part stock and part private, while on the Continent and especially in France they are almost entirely "family businesses" and there are comparatively very few stock companies, in some cases the same family handing down the industry with an increasing, or possibly a decreasing, number of machines and of customers from father to son, to grandson, and to greatgrandson.

DIVISION OF MANUFACTURING OPERATIONS.

In the United States most mills carry on the complete operation of making yarn from wool or else finished goods from yarn, and many buy the wool and turn out the finished product ready for the customer, doing their own washing, dyeing, combing, spinning, weaving, and finishing. Such a thing is almost unheard of in the worsted business in France, and the few of the larger companies that really carry out most of the processes have a separate mill and manager for each. The making of tops is a great branch of the industry in France, the mills in this line doing nothing else and not only supplying their home spinning mills, but exporting millions of dollars worth to other countries.

In the United States it is probable that in Philadelphia, Lawrence, or Providence there will not be found a single mill that confines itself exclusively to making tops, as American conditions are different. In France combing, spinning, and weaving are not only carried out in separate mills, in most cases by separate companies, but the finishing and the dyeing are also nearly always done outside, and there are also many establishments that confine themselves only to the washing of wools. The woolen branch of the business in France is not so universally specialized as the worsted branch, yet even here the dyeing and finishing are usually separated from the manufacturing process proper.

In regard to commission manufacturing, this is rare around Rheims, is largely used around Roubaix, and is the customary practice in the Fourmies-Cateau section. The men in this business who are called "manufacturers" do not usually own combs, spindles, nor looms of any kind. They buy wool and sell tops, yarn, or goods, the work in each case being done by the specialized mills on commission. Of late their field of operation has been somewhat reduced by the fact that many combers have gone into the buying of their own raw materials and selling the tops therefrom, claiming that the competition in the combing line at home and abroad has become such that the commission price for combing in many cases affords them no profit and that they must make their profit on the difference in price of the wool and the tops in order to keep their factory going.

CONSERVATISM IN BUYING NEW MACHINES.

I went through several of the Roubaix-Tourcoing mills. They do not average as large as the American, though the large ones are built in the best style of modern mill architecture and are well operated. The older mills in some cases have less conveniently arranged quarters, and owing to the pronounced conservatism of the French manufacturers there is to be seen a good deal of old machinery, which is well kept up. At one mill I saw looms that had been running for forty years, and the manufacturer said as long as he was making a good profit on them he saw no reason to change. This conservatism and dislike of buying new machines as long as they can make a profit on the old is possibly one factor that has a bearing on the unprogressive state of the industry as compared with more modern competitors like the United States and Italy, where the manufacturers are always eager to see and hear of something new in the machinery

line and to throw away the old for the new if the change will be found to pay for itself.

One of the most up-to-date firms at Roubaix and also one of the largest is that of Alfred Motte & Co. I visited their combing mill and also their spinning mill, the two being located separately.

At the combing mill I was informed that there were operated 150 Offerman-Ziegler combs, 72 Lister combs, and 42 Noble combs, and that their yearly production of tops was some 12,000,000 kilos, which is about 26,000,000 pounds, almost equally divided between their three types of cards. Of this amount they say that usually 70 per cent is La Plata wools, 15 per cent Australian and New Zealand, 5 per cent French and Algerian, with the remainder from South Africa, Chile, Spain, etc. Some 1,600,000 kilos, or 3,500,000 pounds, is washed for export, going to England, Germany, Russia, etc. This factory employs some 2,000 operatives all told, and the motive power consists of two 800 horsepower engines. The mill is a large four-story building with heavy brick walls, iron posts, stone floors, and all modern appliances for making tops and for utilizing the by-products, such as grease, etc.

SORTING AND CLEANING THE WOOL.

The wool is received from Australia and other countries in bales and the first process is sorting. The sorters stand at small tables, which are on a stone floor and under a saw-tooth roof, so that the quarters are clean and well lighted. Each sorter had a bale opened beside his table, and each layer as it was laid on the table was rapidly inspected and the different grades thrown into bags marked 1, 2, 3, and 4. These men get 35 to 55 centimes (100 centimes or 1 franc = 19.3 cents) an hour, according to their ability, and sort 300 to 400 pounds a day.

After sorting, the different grades are stored in separate bins in another room, and from here each kind as desired is carted to the washing room to be degreased and cleaned. On natural wool there are three classes of materials—dirt, sand, and loose vegetable matters, dried perspiration or "suint," and natural grease or yolk. They are removed separately. The dirt, etc., is first shaken out in a willey. The suint or perspiration consists chiefly of potash combined with organic matter which is easily soluble in water, so this is then washed out in a succession of boxes filled with water through which the wool is mechanically driven. This process is known as dessuintage. It is then scoured with alkali to remove the natural grease and then blown over by fan through tin pipes to the cards and preparing apparatus.

Before showing the manufacture of the wool itself I will note what becomes of the materials thus removed.

BY-PRODUCTS.

From the dirty liquid resulting from the "dessuintage" they first extract carbonate of potassium by calcination, using what they call a "Porion" kettle. The liquid is first heated until it is of the consistency of sirup, when it is allowed to spread out; the water evaporates, the organic matters are consumed, and there remains in the

kettle a bluish-gray mass which contains 70 to 75 per cent carbonate of potassium, 3 to 4 per cent of carbonate of soda, and some of the sulphates and chlorides. The potash is refined and put up in iron drums for shipment either to France or abroad, this firm making regular sales to a house at New York. The residue is made into low-grade chemical fertilizers.

The waters of the "lavage" or washing proper are run off into large vats, treated with sulphuric acid and automatically stirred for a couple of hours, when they are allowed to stand for six to eight hours. The wool grease contained it is impossible to saponify completely, but the result is a complete emulsion consisting of soapy particles and water and a portion also sinks to the bottom or collects on top. This latter is skimmed off, being called "lanoline," sometimes "suintine," and is used to make salves which are said to possess special curative powers. The emulsion after partial evaporation of the water is used over again in the mill to clean other wools and thus to cut down the amount of soap used, which is an important economy in a factory using as this one does 50,000 kilos of potash soap a week.

SHIPMENT OF COMBED WOOL—FACTORY WAGES.

To resume the treatment of the wool itself, the short-stapled wools are run through two-card sets and the long wools prepared by going through six gill boxes. The slivers are then backwashed, put through two gill boxes, combed, backwashed, put through two gill boxes, and rolled up into flattened balls weighing 5 to 6 kilos each, and for shipment 20 of these are put into a wooden box bound with iron straps. For tops of which the selling price requires to be lowered the cheaper La Plata wools are mixed with the finer Australian during the processes. The finished tops of La Plata wool sell for about 4.5 francs a kilo and the pure Australian much higher. The wool that is not combed in this factory, but only washed for export to Germany or elsewhere (part being sent to a combing mill owned by the same firm at Warsaw), are put up in 250-kilo bales wrapped in burlap and bound with six wire hoops.

In regard to wages paid at this factory there is no piecework, but everything is by the hour. As above noted, the sorters get 35 to 55 centimes an hour, the washers get 40 centimes an hour, the grease removers 27½ centimes an hour, the carders 33 to 42 centimes an hour (one man to seven cards), the wool carrier 33 centimes an hour, the giller 27½ centimes an hour, and the comber 34 centimes an hour. These were the prices as given me from the books. The mill also runs at night, and as there is no cessation of work when the shifts are relieved there is no stoppage of the machinery from Monday morning to Saturday night. However, processes on which women are employed can only be operated in the daytime, as the law prohibits women or children working in mills at night.

MULE SPINNING.

From this combing mill I went to the yarn mill owned by the same company, situated in another part of the town. This is a plant of 32,000 spindles of which the majority are mule, while some are ring

spindles. The tops come in 5 kilo balls or cheeses. They are put through three sets of gill boxes drawing six into one. They then go to the "bobbinoirs," of which there are four processes. The slivers are drawn two into one and, as previously described, in passing from the back to the front roller they are supported by a small porcupine cylinder, pass between rubbing leathers, and are wound up on horizontal bobbins to go to the mule. Each bobbinoir contains 50 horizontal bobbins. The hands operating the gill boxes, the bobbinoirs, and the few roving boxes used for making roving for the ring spindles are all paid 30 centimes an hour.

In the mule spinning room I found the majority running on yarn measuring 30,000 meters a kilo. From each 500-spindle mule there was required 90 kilos per day. The mules on this yarn were making six 1.5 meter stretches per minute. The operatives are paid a fixed price per day and get a premium for production over that required. For 2,000 spindles there were employed one spinner, three piecers, and one boy. The spinner was paid 45 centimes an hour, each of the piecers 35 centimes an hour, and the boy 20 centimes an hour. With the addition of the premium the spinner's wages, when the work is running well, will reach 6 francs a day, each piecer about 4½ francs, and the boy about 2.75 francs.

RING SPINNING.

The ring frames have five top rollers, of which three are "carrying" rollers. Running on yarn measuring 30,000 meters a kilo the production required when running with good grade material was 70 kilos a day per side of 170 spindles, and I found the speed of the front roller to be 101 revolutions per minute. When lower grade qualities are used the required production figure is reduced, sometimes down to 40 kilos for the same number as above. One girl runs one side, does her own doffing, and is paid 22 francs a week with a premium on work over that required, which occasionally gives her one or two francs per week more.

Some of the ring spinning frames in this factory, instead of having the usual band driving for spindles, were run by means of a line of bevel gears on each side, which geared with other bevels on the long spindles. This gives a positive drive without slip. The spinner said that it was not a new, but an older system, and that the newer frames all had the regular band driving from drum to spindle whirl, as it permitted of higher speed. All the spindles in this factory, both ring and twister, were fitted with knee brakes for stopping the spindle while piecing up.

Part of the yarn was sold in the single and part twisted. In the latter case the bobbins were put on a doubler where two ends were run together on cones without twisting and then each cone run off separately to a bobbin on a twister, thereby twisting together the two ends. There were employed 450 hands in this factory and part of the factory, employing 100 men, worked at night, the remainder of the work being mostly that of women and girls working daytime only.

WEAVING METHODS.

At a 500-loom woolen weave mill, I found that the yarn was bought on the cop, run on to cheeses and these placed in a warper creel, same as spools, warped, slashed, drawn in, and woven; the dyeing, napping, etc., being done by another firm. For drawing-in a man and boy working together on 5-harness work were paid 35 centimes per 1,000 ends, and made together about 5 francs a day. Looms were mostly 140 centimeters wide and ran about 110 picks per minute average. The speed varied above or below this, according to the quality of wool being worked. On some of the "bon marché" or very cheap grades of goods being made the speed was 100 picks or less per minute. There was one weaver to each loom. On looms one meter wide the speed was given me as 150 picks per minute for good grade of wool and weavers ran two looms, in some cases only one. The wages received by the weavers was stated by the management to vary between 18 and 30 francs a week, according to their ability and the class of work they were on, the average skilled weaver making about 25 francs a week.

The productions of the Roubaix factories vary between articles made of pure merino wool elaborately worked and finished and articles made of cheap grade wools with a mixture of rag wool, wool extract, or cotton. Some factories require a much higher grade of skilled labor than others and have to pay accordingly.

SCALES OF WAGES.

To compare the wages obtained by wool workers in various countries, it will be readily understood, can only be done in a general way. Even where averages can be ascertained approximately it has to be borne in mind that the amount and quality of the work required for the different classes of operatives will vary in the different countries; for instance, a girl ring spinner in some places will only spin, in other places she also has to do her own doffing, etc. Though exactly accurate comparisons can not be made, yet by taking the average wages as computed by active manufacturers in the leading centers of the industry in the various countries, the general level of wages can be brought out clearly enough to be of value. In the following table, comparing Italy, France, and England, the figures for the first two countries were obtained personally at Biella and Roubaix, and Bradford wage tables and textile publications have been relied on for the last. The figures in lire, francs (lira or franc = 19.3 cents), and shillings (shilling = 24.3 cents) are as follows for the average weekly wages paid in worsted day work:

	Italy.	France.	England.
	Lire.	*Francs.*	*Shillings.*
Sorters	21 to 27	30 to 36	28 to 32
Washers or dyers	12 to 18	18 to 24	20 to 26
Carders	9 to 15	18 to 24	14 to 20
Gill boxes	9 to 15	16 to 22	11 to 14
Comb minders	9 to 15	16 to 22	11 to 14
Boss spinner	36	48	50
Mule spinner	27 to 33	27 to 36	24 to 36
Ring spinner	9 to 15	20 to 22	9 to 15
Weavers	12 to 18	18 to 30	12 to 20
Fullers and pressers	16 to 20	20 to 24	20 to 30

Reducing the foregoing to dollars and comparing with average American wages in the worsted industry the following table is obtained:

	Italy.	France.	England.	United States.
Sorters	$4.60	$6.40	$7.30	$12.50
Washers or dyers	3.00	4.25	5.60	7.00
Carders	2.30	4.00	3.90	6.00
Gill boxes	2.30	3.70	3.00	6.00
Comb minders	2.30	3.70	3.00	6.00
Boss spinner	7.00	9.25	12.00	18.00
Mule spinner	5.80	6.20	7.30	9.50
Ring spinner	2.30	4.00	3.00	6.00
Weavers	3.00	4.60	4.00	9.00
Fullers and pressers	3.50	4.25	6.00	7.00

The cost of living is cheapest to the operative in Italy, higher in England, still higher in France, and highest in the United States; the wages are lowest in Italy, higher in France and England, and highest in the United States; the productive efficiency of the operative is lowest in Italy, higher in France, still higher in England, and highest in the United States.

BRITISH WOOLEN INDUSTRY.

WOOL WORKING INDUSTRY.

TENACIOUS HOLD OF BRITISH MANUFACTURERS ON THE TRADE—CONSTANTLY SEEKING NEW MARKETS IN THE WORLD.

Wool is grown more or less in all quarters of the globe, but is mainly manufactured in Great Britain, United States, Germany, France, and Belgium.

At the beginning of the eighteenth century woolen goods made up two-thirds of England's exports, and until after the middle of the eighteenth century it was the leading industry. With the invention of the steam engine and the great development of automatic mechanical appliances resulting therefrom wool was removed from the premier position and cotton became king. The cotton industry of Great Britain is now twice as important as the woolen industry, and it is increasing at a more rapid rate, which in large measure is due to the fact that cotton manufacturers sell to the world, while woolen manufacturers still rely largely on their home market. It is estimated that 80 per cent of England's cottons are sold abroad and only 40 per cent of its woolens. Wool, however, still holds the second place, and England still leads the world in the manufacture and export of wool.

The French treaty of 1860 greatly aided the trade with France, and then the American civil war by curtailing the use of cotton gave a great temporary impetus. The Franco-German war paralyzed competition, and for a short period England supplied the wool-goods demands of the world, reaching in 1872 the as yet unexceeded high-water mark of exports of wool manufactures of $195,093,070. The industry being then developed in the United States, Germany, and France there ensued a period of depression for the English manufacturers, but from this they gradually recovered by securing new markets and by specializing in certain lines. The direction in which this stream of goods has been diverted is shown by the fact that in 1872 one-fourth of the woolen exports were taken by Germany alone, nearly one-fourth by the United States, and that less than one-eighth went to British possessions; while in 1907 over one-fourth went to British possessions, as compared with less than one-tenth to the United States and Germany together. In this twenty-five year period shipments of British woolen manufactures to the United States, Germany, France, Italy, and the Continent in general have decreased, while they have very largely increased to Canada, Australia, India, Japan, and Argentina.

VALUE OF THE TRADE.

From 1890 to 1901 the number of operatives in the wool industry in Great Britain decreased from 301,556 to 284,441. There are many who say that as the decrease was almost entirely of half-timers and youthful workers under 20, and as per machine and per operative

there is a much greater output now than formerly, the industry itself did not lose ground. At any rate, there was no progress. From 1901 to 1907 there was an increasing consumption of wool and a rapidly expanding export trade, but there are no statistics to show the present number of operatives. The value of the export of wool and worsted manufactures from the United Kingdom fell from $142,000,000 in 1890 to $112,000,000 in 1894. Many causes contributed to bring about this decrease, among them the fact that in this period British wool dropped 9 per cent in value and foreign imported wools 17 per cent in value. British wool and worsted goods exports reached $149,000,000 in 1895 and $143,000,000 in 1896. In 1901 the value of the exports dropped to $114,000,000, since which time the manufacturers have adjusted themselves to changed conditions in the United States and found new markets, resulting in an export trade in 1907 of $185,600,000.

In studying the trend of the industry it is found that the percentage of cross-bred wool is steadily increasing, that the percentage of reworked or rag wool is increasing, and that the percentage of English wool is decreasing. The price per pound of wool steadily decreased from 1872 to 1901, since which foreign wool has made a substantial advance and English wool a very large advance. The amount of cotton used in the wool trade is steadily increasing. In 1903 it was estimated that 100,000,000 pounds of cotton was used in the wool industry, of which 45,000,000 pounds were used in woolens and 55,000,000 pounds in worsteds. Bradford stuffs are made mainly with cotton warps, and a large amount of the cotton used for this purpose is Egyptian.

CHANGING DEMANDS.

The width and weight of wool goods is increasing, so that a linear yard as used in the export statistics means more than it did formerly. This is due partly to the fact that the raw material and the cost of manufacture per pound has been decreasing, and also to the fact that goods over 54 inches in width are more economical to manufacture and also more economical to cut up. The export of woolen tissues as a whole is increasing, while the export of worsted tissues is decreasing. In 1890, for instance, there were exported 56,485,600 yards of woolen tissues and 172,420,500 yards of worsted tissues, while in 1907 there were exported 84,800,700 yards of woolen tissues and only 99,016,200 yards of worsteds, an increase in the former case of 48.4 per cent and a decrease in the latter case of 42.6 per cent.

English manufacturers recently began to supply their home trade in many lines that they had heretofore left to foreign countries, and they were led to make specialities for which in time they found a new market abroad. The import of foreign wool manufactures into England was steadily increasing until 1897, when they amounted to $49,897,500, being mostly specialties that were not made in England, but since then the English manufacturers have begun working on these lines, and imports have steadily decreased until they are now only $34,101,170.

There is an increasing demand both at home and abroad for frequent changes in style, so that though improved machinery has curtailed the operatives required per pound in the preliminary working

processes it has increased the number of operatives in other branches of the industry. The work of the designer, the pattern weaver, the dyer, and the finisher is now a larger percentage of the total cost than ever before, and as numerous small orders of many designs are now received instead of a few large orders of plain goods, a much larger staff is needed to handle and sell the goods. Formerly the weaver was required to deliver the piece perfect into the taking-in room, but owing to the great variety of makes and more complicated designs this is now impossible, and factories now have to employ very large numbers of menders and burlers.

RAW MATERIAL AND ITS UTILIZATION.

Heretofore England has almost boycotted South American wools on account of its burry quality and has used almost entirely Australasian wools. The Continent, on the other hand, has almost monopolized the South American wool, and by using the "French process" has been able to make good yarns of this cheaper material and to sell them at prices that the English could not touch. In large part, owing to this fact, England excels in men's goods, but France and other Continental countries in the softer women's goods. Less than a fifth of the wool imported into England is of foreign growth, while France, Belgium, and Germany use South American and similar wools to the extent of nearly half their requirements. The specific weight of these wools is less than that of a similar quality of Australian, and therefore the Argentine crossbreds work up closer and make a better faced cloth. They are shorter stapled and therefore better adapted for worsteds and to blend with merinos than long bright New Zealand wools. They are deficient in handle to Australian wools, but are cheaper, and as Continental manufacturers have made a special study of how to treat and finish goods made therefrom they have been enabled not only to make cheap tops, but to make well-finished cloths at a price that defied competition. The English have recently found that they were making a mistake in refusing to use South American wools and that it was resulting not only in their losing opportunities in foreign markets, but also in their home market, so that they are now beginning to adapt themselves to their use, and the small importations of Argentine and Uruguay wools are increasing.

HANDLING THE WOOL.

In studying the handling of the wool between the grower and the manufacturer in the case of the English trade, it is found that only the English and the Australasian wools need be considered, the former being sold at auctions held at stated intervals in various towns, especially London, and the latter being sold either at London or, according to the system now coming into use, in the Colonies. Much of the South American wool is bought by commission buyers or by representatives of European firms in open market at Buenos Aires, Montevideo, or Punta Arenas, who then ship direct to the manufacturers or else resell at Roubaix or Antwerp; but as neither England nor the United States uses much of this wool, 90 per cent of it going to the Continent, it is not necessary to go into the specific terms of these sales in this article.

It will be noted first where England obtains her raw material. The import of wool and other animal fibers into Great Britain in 1907 was as follows:

	Quantity.	Value.		Quantity.	Value.
Sheep and lambs' wool:	*Pounds.*		Other animal fibers:	*Pounds.*	
Australia	321,470,554	$70,991,047	Mohair	31,334,401	$9,868,508
New Zealand	158,406,255	37,252,854	Camels hair	9,952,671	1,591,934
South Africa	91,606,138	16,096,372	Alpaca, vicuna, and llama	5,049,380	1,337,835
British India	46,683,905	7,056,206	Wool waste and flocks	2,546,555	324,357
Argentina and Uruguay	46,147,503	9,444,670			
France	24,486,763	5,781,694	Total	808,120,252	172,223,162
Chile	20,704,208	3,480,954			
All others	49,731,919	8,480,954			

Only a portion of these materials are manufactured separately, the majority being mixed with cotton, silk, or shoddy.

The British cotton trade is dependent on the United States for its main supply of raw materials, taking only a portion from Egypt and a trifle from India, but the British wool trade is independent of foreign sources of supply. Of the 759,237,245 pounds of wool imported in 1907, it is seen that 622,104,166 pounds, or 82 per cent, were obtained within the bounds of the British Empire, and if consideration is given to the total amount of wool manufactured in Great Britain, including the home supply and taking into account the exports and reexports, it is discovered that only a fifth to a fourth is of foreign origin.

PRICES PAID FOR THE PRODUCT.

The average prices paid for home and imported wools in Great Britain for the past twenty years will be given, and then the commercial organizations for handling wool in the home and the colonial markets will be shown. The average prices for the main home and imported wools have been as follows, in cents, per pound:

Year.	Home wools.						Imported wools.						
	Leicester.	Half-bred.	South Down.	Lincoln.	White cheviot.	White highland.	Port Philip grease, good average.	Adelaide grease, average.	Cape, Eastern, average fleece.	Buenos Aires, average grease.	Donskoi, average white carding.	Alpaca (Arequipa).	Mohair.
1888	19½	20	21½	20½	25½	11¾	20½	14	17½	12	14	21½	26
1889	20½	21½	22½	22	26	11¾	23	16½	20½	13½	15	34¾	33½
1890	20½	22½	24	22	26	11½	21½	15	19	11½	14½	36½	31½
1891	19½	20¾	23½	19½	25	11¾	20	13½	17½	10	14	27	26
1892	17½	20	23	17½	24	11½	17½	12	15½	9¾	13½	27	26½
1893	17¾	19¾	22½	20½	23½	11	17½	12	15½	9½	14	29½	30½
1894	19	20½	21¾	20½	23	11	16	10¾	14¾	7½	13	30¾	29
1895	20	20½	21	24	22½	10¾	16¾	11½	14	8¾	14	31½	44
1896	20¾	20	20½	23	21½	10¾	18¾	12¾	15	8½	14	35½	41½
1897	18¾	18½	19	19½	20½	11½	18½	12	14½	8½	12½	28	32½
1898	16¾	16½	18	17½	18	10¾	19½	13½	16½	10½	11½	26	34
1899	15	15½	18¾	16½	15¾	9	24½	17	22	16	11	30	38
1900	13¾	15½	20	15¾	15¾	8¾	23	15¾	19½	8½	11½	29	37½
1901	11½	14¾	16½	13¾	13¾	8½	19	12¾	14	9½	11	28½	36
1902	10	12½	16¾	12½	14½	9	26	17	18½	11½	13	35	30
1903	13	15	20	14½	16½	12	24	16	18	11¾	13½	42	28½
1904	18¾	19	21½	21	20½	14½	26	17	19½	12	18	36	29½
1905	23	24¾	25	25	25	15½	27	18	20½	12¾	17½	33½	29½
1906	25	27½	29½	28½	27¾	17	27	18½	21	13½	18	32¾	32½
1907	26	28	28½	28½	28½	17½	26	18	20	13	17	36½	34½

These figures show clearly the almost continuous decline in wool values down to about 1901 and the remarkable rise that has taken place since. This rise has been due to several causes, but especially to the cramping of the wool supply of the world due to the Australian drought. It seems that the world's wool growth has reached its limit. In Europe the wool supply has not increased for thirty years and in several countries has declined. Unsettled conditions for a time prevented any expansion in South Africa, and the system of small growers does not give promise of any substantial increase soon. In Argentina the farmer is steadily encroaching on the wool-grower and cattle and corn are supplanting sheep; also, malignant sheep diseases are rife, especially the "foot-and-mouth disease" and the deadly "lombriz" or bronchial worm.

Australia now has artesian wells and other means of combating the drought, but this factor will always have to be reckoned with in that country, and the mutton trade, not to mention the gradual settling up of the country, will tend to prevent any rapid advance. In the United States pasturage is being disputed between the cattle rancher and the sheep grower, grazing lands are being cultivated, forest reserves developed, and legal restrictions passed to prevent the former extensive migrations, so that there is not much prospect of any substantial increase in this quarter. Both England and the United States are yearly forced to buy more and more in the international markets.

SHEEP-RAISING INDUSTRY.

In 1868 the flocks of the United Kingdom reached 35,600,000; in 1907 they were estimated at 29,500,000. The United Kingdom carries more sheep in proportion to its area than any other country, but the demand for mutton and lamb will not permit of much increase, even if the size of the country were not taken into consideration. The majority of the sheep are raised for mutton rather than wool.

Owing to their system of mixed farming sheep are to be found in every country in England, and only seven counties contain less than 100,000 each. Yorkshire has 1,750,000, Lincoln and Northumberland over 1,000,000 each, and Devon and Kent over 800,000. Scotland has about 7,000,000, Ireland 4,000,000, and Wales 3,500,000. The English wools are divided into the long, coarse, lustrous wools, of which the most important are the Lincolns and Leicester, the Cotswolds, and the Romney Marsh, all of which are crossed more or less with each other; and the fine, short-wools, of which the South Down is the most important. The English fleeces run from an average of 14¾ pounds, unwashed, Leicester and Lincoln (average washed, 10¾ pounds) to 3½ pounds, unwashed, for the Welsh sheep (2¾ pounds washed fleeces). For 1907 the home clip of Great Britain was estimated at 130,500,000 pounds, of which 34,500,000 pounds were exported, leaving only 96,000,000 pounds for home use. The United States is the most important buyer of English wool, the value being several times as much as the American purchases of English wool manufactures. The Irish clip especially is largely taken by the United States, and in some years this is almost monopolized.

The home trade in English wools is carried on by means of auctions in various towns, especially those of London, Leicester, and

Bradford, and direct purchase of wool by the manufacturer from the grower is rare. The middleman, who is equipped to supply a great variety of different qualities, is a necessity. Among the spinners it has become customary, especially with the smaller ones, to buy tops rather than wool. The tops may be bought direct from a top maker or from a merchant, who buys the wool, has it combed on commission, and then sells the tops to the worsted manufacturer and the noils to a woolen manufacturer. In such cases the wool merchant usually does not buy the wool until he has sold the tops to be made therefrom. Buying tops from wool merchants is often financially more convenient to the spinner, for when buying wool he has to pay cash, whereas the merchant will frequently give him four or even six months' time. This credit system is being broken down, but is still in force in many cases. In the English top markets there are no "futures," or "terme" dealings, as they are called on the Continent, but there is much future delivery business where spinners call for regular deliveries of so much per month and do not pay until delivery. The best spinners prefer to buy and sort their own wool, as otherwise there are frequently much cheaper South American grades mixed in, and once combed it is almost impossible to determine of what clip the top is made.

MARKETING COLONIAL WOOL.

In the sale of colonial wool the most striking feature at present is the fight going on between London and the colonial towns as auction centers, and in this fight London is steadily losing. Formerly there was only one selling center—London—and in 1875 practically all the colonial wool came on the auction floor of the great Wool Exchange, at Coleman street, but in 1890 only 60 per cent of the Australian clip was sold in London, and to-day only about one-third of the Australian and one-half of the New Zealand are sold there.

London has an advantage because of the fact that it handles wool from all over the world and is not confined to any one clip, but as the bulk of the spinners use only Australian wool this is not such a great advantage. In London every bale of wool sold is required to be shown, while in Australia only 10 per cent. Sales in London are strictly for cash, the buyer having to pay in seven days and to remove the wool within fourteen days. The selling brokers charge one-half per cent to the importer, who passes the charge on to his Australian client, while the manufacturer pays one-fourth per cent to the buying broker.

Formerly not only the English but the Continental and American manufacturers bought colonial wools only through the London market. Now there is an increasing tendency toward direct sales, which has been very welcome to the Australian grower as relieving him of the heavy charges he formerly had to pay for numerous middlemen and for London dock charges and also giving him quicker returns. Transporting the wool from the interior of Australia to the shipping port frequently took several months by way of the flat river boats or bullock carts, and then another six months, probably, before the wool was sold in London, making in many cases a year before the grower got his final returns, during which period he was paying interest on advances by banks. The grower first delivered his wool to the car-

rier, who carted it to Sydney or Melbourne. Here the banker had it appraised by a valuer and advanced on it, and the wool, then being under the control of the bank, was turned over to a shipper, who transported it to London, where there were incurred dock and warehouse charges of about 4 shillings (97 cents) a bale; one-half per cent commission was paid to the selling broker, and then 1 per cent to the colonial merchant, who was also responsible to the bank for deficiencies. Finally, if there was anything left after deducting all charges and advances, it was turned over by the bank to the grower.

This method is still followed in some cases, but as the Continental and American buyers go to Australia more and more every year to buy direct the English buyers have been forced to adopt the same plan and the percentage of London sales continually decreases.

COST OF SELLING.

The increasing financial facilities of Australia permit the financing of wool transactions at as good rates, sometimes better, than can be done through London. England sells large quantities of goods to Australia for which gold bullion would have to be sent home by the banks at 25 shillings per £100, or 1¼ per cent. Suppose an English topmaker desires to buy direct. The Australian banks, to save the above exchange, will give the seller a sixty days' after sight draft (besides the five or six weeks for mailing before invoices and drafts arrive to sight) for a nominal exchange, usually about one-half per cent, though sometimes for nothing. If it is done at one-half per cent, the topmaker is getting accommodation at less than 2 per cent per annum and running no risk. Knowing when his wool is to arrive, the topmaker can sell tops to the spinner for future delivery and be out his capital only during the time necessary to manufacture. The spinner in turn has sold for future delivery to the manufacturer. This system permits of lower prices to all concerned than if the topmaker had to pay spot cash at the London auctions and borrow at London rates.

The direct sales have been largely brought about and are mainly carried on by means of huge "pastoral agency associations." These companies combine within themselves facilities for acting as carrier, shipper, banker, seller, and supply agent. They take the wool from the grower, carry it to the nearest port, and sell at auction, remitting immediately to the grower, or else they buy outright and then ship to London or direct to the manufacturer. To-day after raising the wool a grower pays for shearing and other charges 2 to 3 cents a pound, and then, if selling in Sydney, about 1 cent for selling charges, so that his total expense after raising the wool will not be over 3 to 4 cents a pound. By the old method it was much larger. The possibility now of a quick turnover is a very important factor, as it is tending to gradually break up the vast ranch system by inducing many smaller men to start in on their own account.

NEW SHIPPING COMPANIES IN AUSTRALIA.

There are four of these large omnibus companies selling wool in Australia [names on file in the Bureau of Manufactures], and also numerous smaller ones. Recently there have been formed large

farmers' cooperative associations, by means of which the growers themselves sell direct to the manufacturers.

As London is gradually eliminated, wool is going direct to Continental ports and to Yorkshire. Formerly Yorkshire bought through London entirely and reshipments were usually by rail, but already Hull, Goole, and, to a smaller extent, Grimsby are becoming important landing places for wool, and the small takings of South America are also beginning to come in by way of Liverpool and some through the Manchester Ship Canal. The Humber and the Mersey will eventually supplant the Thames in this trade.

The London sales are divided into six series—January, March, May, July, September, and November—but with the increase of direct shipments it is considered probable that the London winter sales in November and January may in a few years be dropped, as they conflict with the chief summer sales in Australia.

POSITION OCCUPIED BY MIDDLEMEN.

In considering the time and discounts allowed in the sale of British woolen and worsted yarns and goods it is ascertained that there is no uniform system owing to the fact that the trade is large, complex, and fluctuating. There is much less uniformity than prevails in the cotton trade, and the trade is much more affected by the vagaries of fashion. The home demand is much more important than the export demand; in the former trade a very large amount of the business is done on a direct basis, but in the latter middlemen are still a necessity.

Between the worsted spinner and the manufacturer there is ordinarily no middleman, such as is common in the cotton-yarn trade, and the sales are made direct. The manufacturer in this case buys yarn either for delivery on a fixed date or else for "delivery as required," in which latter case the trade understanding is that two-thirds of the contract must be completed within six months and the remainder within a further three months. The terms of sale vary, but are usually short, monthly settlements with a discount being the most common.

In the export of yarn some of the spinners sell to foreign buyers at the mill and some of the largest spinners do their own exporting, but this is not customary, and most of the spinners making export yarns have no direct relations with the foreign purchaser, selling to export firms located at Bradford. These export firms are themselves in many cases of foreign origin. In selling yarn to a Bradford export merchant the usual terms are that all sales during a month are to be paid for, with a 2½ per cent discount, on the second Thursday of the following month in a fourteen days' draft on a London bank. The export merchants selling in their turn to foreign countries have no fixed system of payments, as their rules have to be flexible enough to meet the widely varying demands of different countries.

DIRECT SALES AND SHIPMENTS.

In the sale of wool manufactures the goods, whether for home or foreign consumption, formerly went through the hands of merchant firms who specialized in woolens or worsteds, but as the trade has

grown larger and more intricate this class of middlemen has dropped out and been replaced by mercantile houses handling all varieties of textiles, which supply small clothiers, drapers, and small retailers. Much of the home trade is now done direct without any middleman whatever by the manufacturers selling to the large clothiers at London, Leeds, etc. Only the smaller clothiers are now supplied by dealers, and the large retailers also find it more profitable to buy direct.

The terms of sale in the home trade vary according to the section and the specialty, as well as according to individual agreements. The longest terms seem to be those of the Scotch tweed trade, where the customary terms of sale are six months' credit plus an additional four months' bill and then 2½ per cent allowed for cash. In the great clothing center of Leeds the system of payment is equivalent to about four months' time, as the spring goods delivered in January are supposed to be paid for in May and the winter goods delivered about July are supposed to be paid for in November. In the Bradford district long time is exceptional and usually monthly payments are demanded, a discount being given; and in many cases sales are made, with a larger discount, for cash in seven days.

METHODS OF PLACING ORDERS.

In exporting wool manufactures a few of the larger manufacturers do their own exporting, but this is not usual. Some sell to foreign buyers who make trips every season to the mills to inspect the new styles being gotten out, but the bulk of the export trade is in the hands of the "export merchants" and of the "shippers." The difference between the two is that the "export merchants" make their own selections from the season's samples submitted by the mills, order goods made to sample, and trust to their own judgment of being able to dispose of them abroad, while the "shipper" forwards the samples received from the mills to his agents abroad and only orders goods to be made by the mills when he has received specific orders. Both handle the export trade on their own account, but the latter is a safer business in so far as it calls for less capital and risk, and prices can frequently be shaded closer, but the merchant exporter gets his goods on the field first and so frequently gets the trade over the cheaper goods that can not be delivered until later.

Only in certain limited branches of the wool trade is it permissible to "make to stock," as is done in the cotton trade, and the great bulk of the goods are "made to order." In selling to the export merchant the manufacturer sells by the season, as above noted, for the Leeds home trade—that is, two yearly payments, with 2½ per cent discount. In selling to the shipper, who does not have to tie up so much money as does the export merchant, the manufacturers usually require monthly payments.

WOOL COMBING.

A BRITISH MONOPOLY IN PRODUCING WORSTEDS—A LARGE WOOL COMBERS' TRUST.

The manufacture of worsteds in Great Britain is almost exclusively a monopoly of the West Riding of Yorkshire, and factories manufacturing wool in other parts of the country are mainly for woolens. Wool combing, which is a process only employed for worsted yarns, naturally centers in this West Riding, which, according to the inspectors' reports of 1904, contains all except 278 of the 2,924 wool combs of Great Britain. Combing on commission is not as large a business in England as in France or Belgium, but is yet of considerable size. The bulk of the mills that do combing on commission have been bought up and amalgamated into one company called the "Woolcombers, Limited," of Bradford. This company owns 23 branch mills, which contain from 8 to 34 combs each, with a total of 434. These are practically all Noble combs, there being only 6 Heilmann combs and a very few of other types among the total. There are some firms outside of this association that do combing on commission, but as this association embraces a seventh of all the combs of the country it embraces the bulk of all those open for commission work, and the prices fixed by this association are accepted by all.

PRICES FOR COMBING ON COMMISSION.

The product of wool combs are "tops" and "noils." The tops are the long-fibered slivers which have been combed out parallel and wound up into balls weighing about 7 pounds each, ready for drawing and spinning. The noils are the short fibers that have been combed away from the long fibers, and are unfit to be used for worsted. The noils are used in the woolen trade. The wool combers take the wool and deliver back the finished tops and the noils made therefrom. Their prices are interesting for comparison with those in the United States, for they include the total costs of such work plus a profit. Recently they have increased their standard prices by 7½ per cent.

The present (October, 1908) standard prices in pence per pound, to which 7½ per cent is now added, by the Woolcombers, Limited, of Bradford, for combing on commission, are as follows converted into American currency:

	Pence.
East Indian, Egyptian, and kindred wools:	
Whites—	
Tearing 6 to 1 and over	2¾
Tearing 4 to 1 and under 6 to 1	3
Tearing under 4 to 1	3¼
Greys—	
Tearing 6 to 1 and over	3
Tearing 4 to 1 and under 6 to 1	3¼
Tearing under 4 to 1	3½
Medium crossbreds (minimum price; burring one-eighth extra):	
30s to 46s—	
Tearing 6 to 1 and over	2½
Tearing under 6 to 1	2¾
50s	3
56s	3¼
Merinos:	
Tearing over 5 to 1	4
Tearing between 4 and 5 to 1	4½
Tearing between 3 and 4 to 1 [a]	5

[a] Under 3 by special arrangement; burring one-fourth extra.

	Pence.
Merino laps	4¼
Crossbred laps	3¾
Shearlings, low locks, etc.: Minimum price	4
Low foreign wools:	
Tearing over 7 to 1	3
Tearing between 4 and 7 to 1	3½
Tearing between 3 and 4 to 1	3¾
Tearing under 3 to 1	4½
Camel hair:	
Firsts, second Chinas, and second Russian	3½
Third China and Russian	3¼
Minimum price for double combing	5¼
Alpaca and mohair:	
Tearing 6 to 1 and over	2¾
Tearing under 6 to 1	3
Vap mohair: Any tear	3½

All mixtures are considered as low foreign wools and are charged accordingly.

SPINNING ON COMMISSION.

Spinning on commission is not as large a business in Yorkshire as combing on commission, but the total amount thus done is considerable. A good many mills prefer to buy and sort their own wool to be certain of getting exactly the quality and staple desired in their product, and they may comb also, or else have the combing done on commission, but if they use a great variety of yarns they find it pays them to have at least a portion of their spinning done on commission by some outside spinning mill. This is convenient for many reasons, and a mill which does its own combing, sorting, and weaving, but, say, only half its spinning, is able to change quicker to meet the fluctuating demands of the market than if they were entirely self-contained. Supposing the mill only contains "cap" spinning, then they spin most of the nonlustrous yarns that they use, but the portion of yarn made from the lustrous wools that is required will be spun in some outside mill containing "flyer" spindles, and if woolen yarn is also required this is spun in some mill containing "mule" spindles.

Many mills use cotton warps and worsted weft in the Bradford district, so that it is usually worsted weft that is thus spun on commission. Where there is only one special lot to be spun a price may be named per pound, but where a manufacturer has more or less spinning done on commission regularly he is usually charged for this by the "gross of hanks," irrespective of the number within a reasonable range. In Bradford a "gross of hanks" means 144 hanks of 560 yards each, and worsted weft yarns are usually traded in by this quantity, the weight in each case, of course, depending on the counts.

PRICE FOR SPINNING WORSTED WEFT YARNS.

One of the largest manufacturers in the Bradford district says that the present commission price he is charged for having his worsted weft yarns spun on commission is 16 pence or 32 cents a gross. He says some firms are getting this done at 15 pence, but 16 pence is the present regular price among the higher class spinners. He said that this is the uniform price he pays for any numbers from 8s to 60s worsted weft yarns, his mill supplying the tops and receiving back the finished yarn. This price is based on the gross of hanks he receives in return. It is agreed that the amount of waste shall not be over one-eighth. This manufacturer also said that in spinning similar numbers in his own mill he figured on 18 pence as covering similar charges, including waste.

To ascertain the weight of a gross of hanks of any given count divide 144 by the count and the result is the weight in pounds. Thus if No. 8s worsted weft is spun on commission at 16 pence or 32 cents per gross, we find that the weight so spun is 144 divided by 8, or 18 pounds, which is 0.89 penny or 1.78 cents a pound. Similarly for other numbers from 8s to 60s at 16 pence per gross the commission price for spinning per pound works out as follows, reduced to American currency:

Worsted weft.	Spinning price per pound.	Worsted weft.	Spinning price per pound.	Worsted weft.	Spinning price per pound.
	Cents.		*Cents.*		*Cents.*
8s	1.78	26s	5.76	44s	9.76
10s	2.22	28s	6.22	46s	10.22
12s	2.66	30s	6.66	48s	10.66
14s	3.10	32s	7.10	50s	11.10
16s	3.54	34s	7.54	52s	11.54
18s	4.00	36s	8.00	54s	12.00
20s	4.44	38s	8.44	56s	12.44
22s	4.88	40s	8.88	58s	12.88
24s	5.32	42s	9.32	60s	15.32

WAGES IN YORKSHIRE.

EXTENT AND LOCATION OF MILLS—AGE AND SEX OF OPERATIVES—RATES OF WAGES AND COST OF LIVING.

To give a clear idea of the unit cost of production in the various processes employed in the wool industry in Great Britain is a very difficult matter. It would be much simpler in the case of cotton manufacturing, as the machines and processes in that industry have become standardized and uniform wage schedules are made up between organizations of manufacturers and organizations of workers. In the wool industry there is not only a great difference between the two branches of woolen manufacturing and worsted manufacturing, but in each case there is wide room for variations in methods and in number of machines employed.

There is a great variety of materials employed and in the qualities and proportions of mixture of these materials, with consequent variation in production per machine; and as neither the employers nor the employees are strongly organized there is an absence of any universally accepted wage schedules. Certain sections making certain classes of goods pay more than others; thus a Huddersfield worsted weaver gets much more than a Bradford worsted weaver, and there is frequently considerable variation between mills in the town and mills in the country on the same class of goods.

Weavers, warp dressers, warp twisters, reelers, and sorters are usually paid by piecework. Mule spinners also work by piecework, for though a good many are paid by the week they are required to get off a certain production, which amounts to the same thing. Ring spinners are paid by the "side" of so many spindles, but as their wages do not vary in proportion to the counts, and hence the weight of the yarn produced, this is one specific case where it is almost impossible to ascertain what would be considered the unit cost of production. Nearly all other operatives in the wool industry—washers (steepers, feeders, and washbowl minders), gill-box minders, drawers, combers, doffers, dyers, finishers, etc.—work almost entirely by the week, and with the great variation in wages and in materials worked the production per operative, and hence the unit cost of production, is extremely difficult to analyze even for a specific class of goods.

In the following notes I shall endeavor to give an idea of the variations of the industry according to the different sections of the West Riding, show the average weekly wages, and to give some lists of piecework prices that will enable the American manufacturer to get a fairly accurate idea of the wage difference between the wool worker in Yorkshire and in the United States.

CENTERS OF THE INDUSTRY.

According to the latest census of the industrial workers of Great Britain, that of 1901, there were engaged in wool, worsted, and shoddy manufacture 259,909 persons. Wool manufacturing is scattered over very nearly the whole of the United Kingdom, but the main centers are the West Riding of Yorkshire, southeast and west Scotland, the west of England (around Worcester and Bristol), and around Rochdale in Lancashire.

York is the largest shire in England, and is divided into three "ridings," the wool industry being confined to the West Riding. The West Riding has nearly all of the worsted manufacture of Great Britain within its limits, as well as the bulk of the woolen manufacture, and of the total operatives over three-fourths, amounting to 187,204, are in this section. Within the West Riding itself the wool area is limited to the country embraced between the Wharfe, the Calder and the Colne. Woolens are chiefly made in the east and south of this section, worsted in the west and north, though there is no sharp line of demarcation.

Bradford is not the largest town in the West Riding, nor would its factories alone dominate the industry, but it has become the great buying and selling center and therefore the head of the industry in Great Britain. Bradford is a worsted district pure and simple, and its specialty is "stuffs" for ladies wear. In this it uses a great deal of cotton warps. Nearly all of the mohair, alapca, and similar materials used in the country are also worked in mills in and near Bradford. Huddersfield is also a worsted district, but its specialty is heavy worsteds of high grade for men's wear. It also has a good deal of woolen manufacture and the Colne valley above Huddersfield is noted for its medium priced tweeds. Leeds is the headquarters for the heavy woolen district, but now contains also a good many worsted mills. Dewsbury and Batley, in the Leeds section, are the centers for shoddy manufacturing. I will treat the shoddy industry in a separate article so wages given in this report will refer only to regular woolen and worsted mills.

Yorkshire monopolizes especially the combing industry, and the commission combing mills are nearly all in the Bradford district.

DIVISION OF LABOR.

In the woolen industry as a whole about two-fifths are men and one-fifth are women. The work is begun and ended by men, but the bulk of the intermediate processes are performed by women. That is to say, the sorting and washing is a man's job, as is also the dyeing and finishing processes, and few women are here employed. On the other hand, combing, spinning, and weaving is woman's work. There is no clear division between the work of men and women in these intermediate processes, and some of the heaviest work is done by women, but the overseeing, the adjustment of machinery, etc., is always in the hands of the men. In the Bradford section the weavers on the narrow "Bradford stuffs" are nearly always women, and in fact throughout Yorkshire women are usually employed on light, fast-running looms. In the Huddersfield section, where the looms are heavy and

average about 80 inches width, the weaving is mainly in the hands of the men. Women are also employed for weavers on such wide looms, but the custom is to give the men the preference by a 15-per-cent difference in the piecework schedules.

Workers in the wool industry of the United Kingdom do not receive as high nor as regular wages as workers in the cotton industry, which is due to the difference in conditions, the greater variations in the methods of manufacture, and also probably to the more scattered state of the industry and the fact that the wool workers are not strongly organized. It is estimated that 80 per cent of the cotton goods made in England are exported and only about 40 per cent of the wool goods, which possibly also affects the question. The variations in the demand sometimes affect whole bodies of workers adversely, and the wool combers in general, but particularly the night wool combers, are frequently out of work for long periods at a time.

WOOL SORTING.

The first process after the wool arrives at the mill is that of "sorting" by hand. In 1901 the census, which gave 209,740 workers in the wool industry as a whole, classified 4,978 as engaged in woolworking, and of these 3,930, or about 80 per cent, were in the West Riding. Formerly the wool was bought by a "wool stapler," who sorted it into different grades, according to the quality and length of staple (hence the name wool stapler), and then sold these different sortings in small lots to the manufacturers according to their requirements. With the growth of the wool industry this system has been done away with; the wool stapler is now only a wholesale merchant, and the manufacturers do their own sorting at the factory.

"Sorting" is a very general word as employed in the trade, for it may cover anything from simply skirting the fleeces to dividing them into a dozen different qualities. The unit cost of sorting, therefore, varies greatly. Fleeces arrive at the factory in different sized bales, but those from Australia are supposed to weigh 400 pounds each of greasy wool. Very frequently a manufacturer will not use all the different grades of wool to be found on a fleece, but in such case he will buy such fleeces from which he can get the largest proportion of the type that he desires, and then sell the other sortings to another manufacturer. The fleeces are usually bought in uniform lots, either of crossbred or merino and according to the type of breed, length of wool, hog or wether, etc. As above stated, a skilled sorter can pick out from one fleece a dozen different qualities, but ordinarily it does not pay to sort over six. With the advance in fancy woolens sorting tends to become more and more careless, and at some factories fleeces after being bought in uniform lots are simply skirted and the fleece as a whole then thrown into one of two or three piles, according to its general appearance, and the whole fleece wool is then started through the processes of manufacture. The costs of "looking over" in this style, or of simply tearing off the soiled "britch" and then sorting into two or three qualities, and the costs of careful sorting into six or eight types will of course be quite different. English and crossbred wools are more usually really "sorted," while merinos are ordinarily only "looked over" after having been "classed" at the station.

WAGES PAID.

Wool sorters are sometimes paid by the day, but more often by the "pack" of 240 pounds. As the extent to which the sorting process is carried is so different in different cases there can be no uniform rules established for all cases, but in the Bradford district the following may be taken as the average piecework wages:

Merinos.—One shilling per pack when looked over, i. e., when sorted for low quality.
Colonial crossbred.—Sorting for 32s, 36s, 40s, 46s, and 50s qualities, 15 to 18 pence per pack.
English wools.—Three shillings to 5 shillings 6 pence per pack.
Mohair.—Turkey, 9 shillings 6 pence, and Cape, 5 shillings 6 pence per pack.

The average good wool sorter makes from 28 to 33 shillings ($6.80 to $8) a week, so from this can be figured the amount sorted a day. An extra good sorter sometimes makes up to 35 shillings or even 40 shillings, but there seems to be a general understanding among sorters that as a rule they shall not exceed 32 shillings. Their reason for this is easily seen.

As a specific instance of a mill where the sorting is done very carefully, I give the following wage schedule for wool sorters, which is copied from the board on the wall in a large mill near Bradford. Prices are per 240-pound packs:

English wool, etc.:	s.	d.	Mohair, etc.:	s.	d.
Mixed hogs	5	6	Choice Turkey	10	3
Mixed wethers	4	6	Fine Turkey	8	0
Bulk hogs..... 4s. 6d. and	5	0	Average Turkey	7	6
Bulk wethers	3	6	Cape kids	8	3
New Zealand, fine	3	0	Alpaca	20	0
New Zealand, strong	2	6			

The above are the piecework wages by which most of the work is performed, but some sorters are paid by the day. The manager gave the following as the average weekly wages made by the wool sorters at this mill:

	English wool.		Mohair.	
	Winter.	Summer.	Winter.	Summer.
	s.	s.	s.	s.
Piecework, sorter	28	35	30	35
Day sorter	25	31	30	33

The sorting at this mill is very carefully performed and the wages average somewhat higher than those I gave above as usual in the Bradford section. From the piecework wages, together with the average weekly wages above, there can be figured the amount sorted on an average for each kind of wool per man. Thus, on the mixed hogs the average first-class sorter in summer will handle something over 250 pounds, while on the coarse New Zealand he will handle fully 500 pounds.

SORTING CLASSIFICATIONS.

The wool at this mill was sorted for six qualities. The wool sorting was carried on in a long, narrow, well-lighted room by men standing

at long continuous tabling along the walls on either side. Each man had his own particular section of the table, and as he sorted each fleece he threw the different qualities into the various roller carts (each about 2½ by 3½ feet by 3 feet 3 inches deep) which were grouped around him. When full, these carts were rolled across the room and each lot examined and resorted by another sorter to insure correctness of grading.

The mohair sorting was carried on in a separate room. This room had stone flooring, and running underneath the whole length of the tabling was a large tin pipe, and at the end an exhaust fan to create a suction. Over an opening in the exhaust pipe in front of each sorter there was inlet a wire screen made of ⅛-inch meshes one way and ¼-inch meshes the other, and as the wool was opened out on this screen the induced draft carried away the impurities, dust, etc., and discharged it outside the room. The workers' tables were about 4 feet high.

The screened tabling is sometimes also used for ordinary wool, but it is by law obligatory for Van mohair, alpaca, East Indian cashmere, and camel hair, as sorting these articles is classed among the "dangerous trades." This is due to the risk of the worker contracting anthrax, which, when it first appeared some seventy years ago, was called the "wool-sorters' disease." Bales of Van mohair and "Persian locks," which are most liable to carry disease, are not allowed to be opened until they have been steeped in water. The law is very particular in specifying all precautions to be taken in this work, such as the conditions under which meals are to be eaten, the details of the wash-room fixtures, the nail brushes, etc., to be used at the mill, the overalls to be worn, the general conditions of cleanliness to be observed, etc., so as to avoid all risk of the workers contracting or spreading anthrax or other contagious disease.

LEARNERS IN THE TRADE.

In regard to apprenticeships, this is still usually required, but the very long periods formerly required, which were in some places seven years or more, are being cut down considerably. Ordinarily now an apprenticeship is from two to four years, according to the mill and the class of work to be done, and the two-year period is becoming the most common. Where only two years is required the first year is devoted to the rather uninviting task of clipping off burs, dung, dirt, tar, etc., from the fleeces for which the apprentice receives a fixed wage of 10 shillings ($2.40) a week. During the second year he is put on piecework at the regular rates but has to return to the firm one-fourth of the wages made. After the two years he is paid by the piece.

In the case of the particular mill above noted, where very careful sorting is necessary, I found that they still require a full five years' apprenticeship, which is now unusual. In this mill the apprentice the first year receives 8 shillings ($1.92) and this is then increased by 1 shilling a year to 9, 10, and 11 shillings ($2.16, $2.40, $2.64, respectively) per week. He then starts on piecework and pays back one-fourth of his wages to the firm, and only after the full five years does he get full wages.

QUALITIES AND FLUCTUATIONS.

Wool from a fleece is sorted into different piles, which in some mills are denoted by special names, but usually only by numbers or the qualities into which they will spin. A "quality" here refers to a yarn count; thus wool being sorted for 36s worsted means that all wool suitable for making worsted yarn of which 36 hanks of 560 yards go to a pound will be thrown into that pile.

English wool, except Downs, are usually sorted into suitable lots for 30s to 40s; Australian crossbreds into lots for 36s to 58s. Crossbreds are not suitable for yarns over 60s, the higher counts being made from merino wools. South African and Argentine merinos are suitable for 60s to 66s, and the Australian merinos for 60s to 90s. Some special brands of the Australian merinos, like "Ercildoune," etc., are sorted for as high as 100s quality.

The wool sorting as a whole suffers from fluctuations almost as much as wool combing. In 1907 a deputation from the Bradford Woolsorters' Society and the National Union of Woolsorters had a conference with the wool trade section of the Bradford Chamber of Commerce, to whom they appealed to take some measures with a view of relieving the suffering and privation during certain parts of the year consequent upon lack of employment among wool sorters. They suggested a more equitable distribution of what work there might be among the whole of the men instead of some being dismissed and the remainder being kept on full time, and the manufacturers agreed to take this into consideration.

WASHING AND DRYING.

After sorting and being run through a willey to knock out the dust the wool is washed to remove the impurities and dirt, and also to separate from it the wool fat and wool perspiration. The washing is carried on by means of a series of troughs or "bowls" through which the wool is moved by a succession of mechanically driven forks to rollers, which squeeze it out and pass it on. The longer and coarser wools are then dried artificially by a hot-air process, either "table" or "machine," but the shorter and finer grades are ready for working with only the drying given by the squeezing rolls. The ordinary three-bowl washer, using about 10 packs a day of greasy wool, employs two operatives, who are paid by the week, averaging about 20 shillings each.

PREPARATORY PROCESSES AND SPINNING.

From the cards, where start the manufacturing processes proper, up to the spinning there is practically no piecework, and everybody is paid by the week. As a rule the girls on the drawing and combing are the lowest paid of any in the industry. As the wages in the preparatory processes vary little, if any, according to either the quality or quantity of the work put through, such a thing as "unit cost of production" can not be averaged.

I give below the average wages paid workers in the Bradford district, showing in contrast the averages as furnished by the unions and by the manufacturers. The union figures were furnished by the central office of the trades council at Bradford. This trades council represents, as they inform me, 21,000 workers, and each union pays

to the central organization 3 pence per member per annum. The dyers are strongly organized, having about 95 per cent of their members in the union, but the spinners and weavers are little organized and the combers scarcely at all. Only about half of the total operatives in the Bradford district belong to any union, and, taking the Yorkshire industry as a whole, the proportion is still less.

Following are the average weekly wages in the Bradford district, as furnished me by the central union and by large manufacturers:

	Union figures.	Manufacturers' figures.		Union figures.	Manufacturers' figures.
	Shillings.	*Shillings.*		*Shillings.*	*Shillings.*
Day sorters	28	28	3 side spinners (72 to 100 spindles per side)	7½- 8½	8 -14
Piecework sorters	28 -32	28 -35	Half-time spinners	1½- 3½	2¾- 4
Wool washers:			Doffers	7½- 8½	8 -10
Day work (55½ hours)	18 -22	18 -26	Warp dressers (men)	30 -34	30 -38
Night work (63¾ hours)	18 -25	20 -26	Warp twisters (men)	32	30 -38
Women on cards	12 -14	12 -14	Women weavers on 2 narrow (40-inch) looms	8 -16	12 -17
Men willeyers and card "fettlers"	20 -25	22 -28	Spinning overlookers	26 -30	30 -36
Women combers, day work	12 -14	12 -14	Assistant overlookers	20	20 -30
Men combers, night work	18 -24	18 -26	Dyers (54 hours' work)	24 -28	24 -28
Box minders	12 -14	12 -14			
Drawers	9 -11	9 -13			

Except where specially shown, as for instance fifty-four hours in case of dyers, the hours per week are fifty-five and a half, which is the legal limit for the work of women. Night work is always by men, women not being allowed to work between 9 p. m. and 6 a. m. The maximum weekly hours for half-timers between 12 and 14 years of age is thirty-two and a half. Where men only are employed, as for instance on night work, there is no legal limit.

VARIATION IN OPERATIONS.

The foregoing wages may be taken as typical of the Bradford worsted industry, but there is more or less variation between the mills in the town and in the country, and there is no uniformity even between two mills running side by side.

A manufacturer whose mill is in a small village about 10 miles from Bradford gave me the following as the wages now being paid in his mill and in four neighboring mills. He had just made these up to show his operatives, who had complained that they were not getting as much as those in some other mills, but when the figures were made up it was found that his mill (shown as No. 1) was actually paying in most cases more than neighboring mills and the discontent was quelled. The figures are as follows and show average weekly wages in five Bradford country mills:

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.
Drawing room:	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*
Can gill minders	15 0	11 0	12 0	12 0	11 6
Drawers	15 0	11 0	12 0	12 0	11 0
Rovers	12 0	9 0	12 0	12 0	11 0
Spinning room:					
Roving girls	9 6	8 0	11 0	.....	.....
Spinners, 4 sides	12 0	10 6	12 6	12 0	14 0
Spinners, 3 sides	9 0	.....	.....	10 6	12 0
Spinners, 2 sides	.....	7 6	9 0	8 6	9 0
Half time spinners, 2 sides	.....	.....	.....	4 0	4 0
End lappers	9 6	8 0	10 6	8 6	9 0
Takers off	9 6	8 0	8 0	8 6	9 0
Bobbin letters	9 6	8 0	8 0	8 6	9 0
Full time doffers	9 6	7 6	9 0	8 6	9 0
Half time doffers	4 3	3 6	4 3	4 0	4 3
Jobbers (head doffers)	10 6	8 6	10 0	10 0	10 0

Mill No. 1 was running flyer spinning frames of 144 spindles each, and about half of these were equipped with the Arnold-Forster doffing motion (made by Hall & Stells, of Keighley) by which, with the assistance of only two doffers, instead of the eight usually required, an entire side of bobbins are doffed at one time with a total stoppage of less than a minute instead of the three minutes usually required.

The head overlooker in spinning at this mill (corresponding to boss spinner) was paid £4 ($19.44) a week, the assistant head overlooker 48 shillings ($11.52), and the other overlookers 35 shillings ($8.40) a week. The warp twisters (men) at this mill averaged 30 shillings ($7.20), the warp dressers 35 shillings ($8.40). (Work in this department very irregular.) When working, the mechanics were paid 32 shillings ($7.68), the head engineer on 800 horsepower 60 shillings ($12), the head weaving overlooker 50 shillings, and the weaving overlookers 35 shillings.

VARIATION IN SPINNING.

Woolen yarns here as elsewhere are always spun on the mule, but in Great Britain worsted yarns are always (with exception of probably half a dozen mills using the French system) spun on either the fly, cap, or ring spinning frame. The brilliant wools are always spun on the fly spinning frame, as this keeps the yarn more parallel and with less twist than is possible with either the cap or the ring frame, so that the natural luster is better preserved.

The Bradford district being a worsted section has little mule spinning, which obtains to a larger extent in the Leeds section. Huddersfield has both worsted and woolen spinning. I found that the women spinners on frame spinning averaged about 12 shillings ($2.88) a week and the men spinners on the mule about 25 to 30 shillings ($6 to $7.20).

In mule spinning the wages depend largely on the class of work. For a mule spinner in charge of one pair of mules in the Leeds heavy woolen district 30 shillings is the rule per week; somewhat more if paid by the piece. Two pairs of mules bring the spinner 35 to 40 shillings.

At one large mill in Leeds I found a spinner and two piecers running a pair of mules of 720 spindles total on No. 36s from English wool. The spinner was paid 7 pence (14 cents) an hour, which is at the rate of 32 shillings ($7.68) a week, and the two piecers were each paid 18 shillings ($4.32) a week. There is very little indirect payment, and it is only in a few of the coarser yarn mills that the custom obtains of paying the spinner and letting him engage his own help.

WEAVING, ETC,

The weaving wage is the largest single wage item in making cloth and so forms a good basis of comparison between wage costs in different countries. In this connection it is interesting to note a comparison that has been made by a Yorkshire expert who recently visited American worsted mills. He states that American worsted weavers average $12 to $15 a week and some run up to $24 a week. Similar weavers in Yorkshire average 13 to 17 shillings a week ($3.16 to $4.13), with a limit for the best weavers on men's

fine worsteds of 30 shillings ($7.29). He states that the American weavers as a whole probably average three times as much as Yorkshire weavers, and contrasting the average manufacturing conditions in the United States with Huddersfield (the most highly paid section of the English wool industry) he obtains the following figures (for men's wide worsteds) as the total cost of manufacture: From raw material to finished cloth, United States 1.5 cents per yard X picks per inch; Huddersfield 0.75 cent per yard X picks per inch; from yarn to finished cloth, United States 1 cent per yard X picks per inch, Huddersfield, 0.5 cent per yard X picks per inch.

Such a comparison is bound to be more or less general owing to the great variety of goods classed under the head of worsteds, but the author stated in private conversation that, from a contrast he made of figures obtained in the United States with figures in England in mills making the same class of goods, the American costs in most cases showed just about twice as high

PREDOMINANCE OF WOMEN.

The bulk of the weavers in the Yorkshire wool district are women. In Bradford, especially, they are practically all women, while in the Huddersfield district, which is an exception to the rule, they are mostly men. In Leeds district they are mainly women, but there are also a good many men weavers. As a rule, the weavers on narrow looms (28 to 44 inches) are women, each of whom runs two looms, while the weavers on wide looms (60 to 90 inches) are mainly men, who run one loom each. There is no very clear division, however, and districts making a specialty of one class of goods have more or less mills on the specialty of some other district. Thus Bradford is noted for worsteds for women's wear, especially "Bradford stuffs," and the weavers are women who average about 15 shillings ($3.60); but there are also in this district a good many mills making "coatings," woven by men weavers, who average nearly as much as the men weavers on the Huddersfield specialty of men's fancy worsted, making from 20 to 25 shillings ($4.86 to $6) a week. Leeds is the center of the heavy woolen district and therefore uses wide looms operated partly by men and partly by women, but it now has also a good many narrow worsted looms operated mainly by women. Throughout Yorkshire, as a whole, it may be said that women run two narrow worsted looms and men one wide woolen or worsted loom. On very narrow goods a weaver sometimes runs over two looms, but this is exceptional.

A board of trade inquiry published by the British Government in 1908 gives the following as the average wages of women weavers in the four main centers in shillings (1 shilling = 24⅓ cents):

	Bradford.	Huddersfield.	Halifax.	Leeds.
	Shillings.	*Shillings.*	*Shillings.*	*Shillings.*
One-loom weavers	.....	15–21	12–16	10–16
Two-loom weavers	13–17	.....	13–17	.....

LOOM SPEEDS.

For a clear idea of the wages it is necessary to take into consideration the type of looms used and the speed at which operated. In the cotton trade, looms on staple goods have standard speeds, but in the wool trade there is such a great variety that it is very difficult to give any standard speed, even for a specific width loom on specific cloth, for the reason that the materials vary, so that giving the warp counts does not give any clear idea as to the strength of the warp. The 1908 Wool Year Book, however, gives the following as showing the general range of speeds in the Yorkshire wool districts:

Type of loom.	Picks per minute.
90-inch reed space, heavy woolen or worsted coating loom	75- 95
90-inch reed space, medium woolen or worsted coating loom	90-105
76-inch reed space, worsted coating loom	105-140
40-inch reed space, plain dress goods loom	180-210
40-inch reed space, drop-box dress goods loom	140-150
40-inch reed space, circular box dress goods loom	150-170
40-inch reed space, single lift dobby	120-140
40-inch reed space, double lift dobby	140-180
40-inch reed space, single lift jacquard	120-130
40-inch reed space, double lift jacquard	160-180

In the woolen industry there are two main types of looms—

(1) The heavy woolen loom with reed space up to 154 inches and a speed for 110 inch reed space of 90 picks per minute. This loom is adapted for the heaviest woolen goods and is very strongly built with heavy framing and gearing. The treading motion for 2 to 6 cams is usually inside the loom, and the shuttles used run up to 9 inches long by 2⅛ inches diameter. As ordinarily made by the firm of Geo. Hattersley & Sons the lay is underswung, but some woolen manufacturers still cling to the old "overswung" type, which is now elsewhere only used on hand looms, especially for very heavy woolens woven at a speed of 50 to 60 picks per minute, as they claim it gives a heavier compacted cloth with less strain on the warp.

(2) The second type, the medium woolen and worsted serge (Dobcross) loom as constructed by Hutchinson, Hollingsworth & Co., is made with a dobby capacity up to 36 shafts, is of the underpick type, and for a 90-inch reed space can be run up to 105 picks per minute.

For worsted looms we find—

(1) The medium and heavy weight coating or tweed loom, which is usually of the overpick type and fitted with a four-shuttle rising box at either side, for odd and even picks. Pirns are used in the shuttles up to 8 inches length by $1\frac{9}{16}$ inches diameter. For an 84-inch reed space the loom is run up to 105 picks per minute.

(2) The one shuttle coating loom for 76-inch reed space, 28 shafts, the speed will be about 140 picks per minute. On these, as on most other worsted looms, the treading motion is at the end of the loom, as this is easier to get to, and in the worsted trade there has to be frequent change of patterns.

(3) The plain one shuttle dress goods loom more nearly approaches in design and speed the looms as used in the cotton industry, and in fact a large part of the Bradford stuffs are made with cotton warps. For a 40½-inch reed space this loom can be run up to 210 picks per minute with first-class material.

(4) The revolving box loom to weave checked goods of medium weight with six or seven shuttles is used to a fairly large extent, and with a 36-inch reed space can be run up to 190 picks per minute. The Keighley nonpositive dobby as made by Hattersley is used for looms up to 47-inch reed space. A good many Jacquard looms are used, and the following sizes are given by Professor Barker as the standards for the respective districts: Bradford 300, 600, 1,200; Huddersfield, 200, 400; Manchester cotton district, 400.

The wide looms used in the Huddersfield district are mainly of the Dobcross type, as made by Hutchinson, Hollingsworth & Co., of Dobcross, in the West Riding of Yorkshire, while the main loom used in the weaving of narrow worsted is the outside tappet style as built by Geo. Hattersley & Sons, of Keighley.

As a rule the underpick motion is used for heavy fabrics and wide looms as giving a stronger blow to the shuttle. It is also cleaner, as there is no danger of the oiling getting on the cloth, and there is a saving in picking-strap expense. The overpick motion is, in England, usually applied to fast running looms, as it is claimed that the movement of the shuttle being more gradually applied a smoother pick is obtained.

VARIOUS WAGE LISTS.

In the Bradford and Leeds districts where men and women work on the same goods they receive the same wages, according to the piecework schedule. In the Huddersfield section, however, men weavers are given the preference by a 15 per cent difference in the piecework prices.

Pattern weavers in the mills usually work on hand looms, as there is only needed short lengths, which have to be very carefully made, and the pattern is changed at frequent intervals by taking out or putting in more ends, etc. These are picked weavers and are paid by the day according to their skill. As a rule they average higher than other weavers and get up to 30 or 35 shillings ($7.20 to $8.40) a week.

The overlookers or tuners (American loom fixers) look after about 24 wide looms and get about 35 shillings a week. The number of looms they tend, also their wages, are variable. Some get less than 30 shillings and others up to 40 shillings, but 35 shillings is assumed to be their standard wage. The head overlooker, corresponding to our boss weaver, usually gets 50 shillings, and the assistant head overlooker 40 shillings, but here also there is great variation according to the size of mill and the kind of goods. Some head overlookers get up to £4 ($19.44) a week, but above this is very rare. Head carding overlookers, as a rule, are paid more than head weaving overlookers.

BRADFORD RATES.

In the Bradford district there has been made up a standard wage list for weavers which was adopted by the Bradford Chamber of Commerce after consultation with the Bradford Trades and Labor Council.

This list was made up several years ago and has not been adopted uniformly by the trade owing to the independence of the manufacturers and also to the many variations in goods and methods of manufacture, which no uniform list will fit. I have been informed, however, by several of the larger manufacturers that they are now paying according to this list, and that it can be accepted as representing the average conditions of piecework payment to weavers in the Bradford section of the industry. This list is as follows:

Dress goods, linings, etc., for 70 yards warp.

Price in pence per pick per one-fourth inch.]

All weaves up to and including 8 shafts, woven with any one color of warp with white weft:	Pence.
Up to and including 38-inch reed space	2
Above 38-inch but not exceeding 47-inch reed space	2⅛
Above 47-inch but not exceeding 57-inch reed space	2¼
Above 57-inch but not exceeding 66-inch reed space	2⅜
Above 66-inch but not exceeding 76-inch reed space	3¼

For variations there are added the following extras to the above prices:

	Up to and including 57-inch reed space.	Above 57-inch reed space.
	Pence.	*Pence.*
1. White mohair and mixture or colored weft other than alpaca ..... per pick	¼	⅜
2. (*a*) Alpaca, gray; plain weave (IXI) ..... do	⅜	1½
(*b*) Alpaca, gray; twills ..... do	½	1
3. (*a*) Single twist botany warps, over 72 set and with more than 18 picks per ¼ inch ..... per pick	⅜	1
(*b*) All other single-twist worsted warps ..... do	¼	½
4. Stripes in warp, up to 8 shafts, inclusive:		
(*a*) Up to 4 colors inclusive ..... do	¼	¼
(*b*) 5 colors or more ..... do	¼	⅜
5. Drafted stripes, with or without extra shafts ..... do	¼	½
6. Shafts above 8, whether dobbies or tappets ..... per shaft	1	2
7. (*a*) Boxes, up to and including 3 shuttles ..... per pick	¼	⅜
(*b*) Boxes, above 3 shuttles ..... do	⅜	1
(*c*) Skip or drop boxes ..... do	¼	1½
8. Pick and pick looms ..... do	¼	1½
9. (*a*) Jacquards ..... do	½	¾
(*b*) Jacquards with alpaca weft ..... do	1½	2
10. Cop weft ..... do	¼	¼
11. Weft of 16s count and thicker ..... do	¼	⅜
12. One weaver to one loom (for special weaves) ..... do	.....	1½
13. Rollers or extra beams ..... per piece	4	8
14. Below 9 picks ..... do	2	4
15. Warps of 140 yards or shorter ..... for whole warp	6	6
16. One end of warp in one reed ..... per piece of 70 yards	3	6
17. Extra for finding pick, excepting all plain (IXI) weaves and goods made from alpaca ..... per piece of 70 yards	3	6

Coatings.

	1 weaver to 1 loom.	1 weaver to 2 looms.
Up to 84-inch reed space, speed 120 to 130 picks per minute, 70 yards warp:	*Pence.*	*Pence.*
All weaves up to 8 shafts ..... per pick	.....	3¾
All weaves up to 12 shafts ..... do	5½	.....

For variations there are added the following extras to the above:

	1 weaver to 1 loom.	1 weaver to 2 looms.
	Pence.	*Pence.*
1. Plain drafted stripes, up to 3 colors.....per pick..	¼	¼
2. Plain drafted stripes, 4 colors or more.....do....	½	½
3. Cross-drafted stripes, up to 3 colors.....do....	½	½
4. Cross-drafted stripes, 4 colors or more.....do....	1	1
5. Colored weft, except where color is paid for in the warp, as in Extras 1 to 4.....per pick..	¼	¼
6. Revolving boxes.....do....	1	1
7. Skip or drop boxes.....do....	1½	1½
8. Jacquards.....do....	½	½
9. Looms running 110 to 119 picks per minute.....do....	1	1
Per piece:		
10. Above 8 shafts.....per shaft..	.....	1½
11. Above 12 shafts.....do....	1½	.....
12. Above 80 set.....each 5 set..	1	1
13. Above 2 shuttles.....per shuttle..	9	9
14. A second beam.....per piece...	12	9
15. Below 9 picks.....do....	9	9
16. Warps shorter than 140 yards.....for the whole warp..	18	12

HUDDERSFIELD RATES.

The foregoing prices are for goods as woven in Bradford district, where the main goods are women's worsteds and linings, and the women weavers usually run two narrow looms each. In the Huddersfield section the main specialty is men's worsteds, and usually one man runs one wide loom (62 to 90 inch reed space).

In the Huddersfield section the weaving rate is usually based on the "string" of 10 feet. There are variations in weaving price according to circumstances, but the following is the piecework rate that has been adopted by the Huddersfield manufacturers and that is generally in force:

[For men weavers on wide looms running 80 picks per minute in pence per 18 strings of 10 feet each.]

	A. One shuttle.	B. Two shuttles.	C. Three shuttles.	D. Four shuttles.
For woolens, mixtures or solid colored worsteds:				
1. One beam...	3d. X number of picks per inch with 1s. added.	5 per cent on column 1 A.	10 per cent on column 1 A.	17½ per cent on column 1 A.
2. Two beams..	.....	22½ per cent on column 1 A.	27½ per cent on column 1 A.	35 per cent on column 1 A.
For colored worsteds:				
3. One beam...	5 per cent on 1 A....	5 per cent on 1 B....	5 per cent on 1 C..	5 per cent on 1 D.
4. Two beams..	.....	37½ per cent on 1 A..	42½ per cent on 1 A.	50 per cent on 1 A.
For looms running 110 to 120 picks:				
5. One beam...	5 per cent off 1 A....	5 per cent off 1 A....		

Add 9 pence per cut for every two healds above 16, and add 6 pence to 1 shilling for odd cuts, according to the picks per inch.

The above wages are for men on single wide looms. For men running two looms there will be paid 35 per cent less than above scale.

Women's scale.—Deduct 12½ per cent from above men's scale. For single white worsteds, 1 beam, 1 shuttle, pay 2.6d. X picks per inch. For serges, 1 beam, 1 shuttle, pay 2.12d. X picks per inch.

LEEDS FINE WORSTED PRICES.

In the Leeds heavy woolen district where there are made many styles of goods, from shoddy to fine worsteds, there is no uniform scale recognized by the manufacturers. One large manufacturer operating a fine worsted mill (wide looms) in the country near Leeds gave me the following as his rate of wages to weavers, there being no difference in rate between men and women:

Plain looms.—Rate: One and one-half pence per pick in 1 inch for 60 yard cut. Extras: Six pence for 18 shafts, 1 shilling for 24 shafts, 1 shilling 6 pence for 30 shafts, 6 pence for mixtures, 6 pence for woolens, 1 shilling for 2 beams, 6 pence for every 10 sets above 100. Looms with box at one end 1 shilling per piece extra.

American fancy looms.—Rate: Two pence per pick in 1 inch for 60-yard cut. Extras: One shilling for each shuttle above 1, 1 shilling for double beam, 6 pence for mixtures, 6 pence for woolen weft, 6 pence for 24 shafts.

Hattersley four-box looms.—Same as fancy looms, but with one-twelfth off. Extras: One shilling extra for all cut warps.

OTHER LEEDS' COSTS.

In the above-mentioned fancy worsted mill near Leeds the piece-work prices for healding, twisting, and dressing were as follows:

Healding and twisting.—Twisting single beams, 5 pence per 1,000 ends; twisting double beams, 6 pence per 1,000 ends; twisting second beam in frame, 6 pence extra; twisting, loom, 6 pence extra per beam; twisting 2/10s. yarns and under, 10 pence per 1,000 ends; side looming, 1½ pence per 100 ends; slaying, 3¼ pence per 1,000 ends over 2 per reed, 4¼ pence per 2 reeds. Extras: Two pence per warp casting out, 2 pence per warp filling up, 4 pence per warp for broken lease. Extra for beams in looming same as twisting.

Time rate, 6 pence per hour. Winding on patterns, 4 pence for narrow under 20 yards, 7 pence for broad.

Dressers' price list.

[All warps with ends less than 2,000 to be paid for as 2,000.]

Ends in warp.	First cost.		Per cut afterwards
	s.	d.	d.
2,000 to 2,500	2	1	3
2,501 to 3,000	2	4	3
3,001 to 3,500	2	7	4
3,501 to 4,000	2	9	4
4,001 to 4,500	3	0	4½
4,501 to 5,000	3	3	4½
5,001 to 5,500	3	6	5¼
5,501 to 6,000	3	9	5¼
6,001 to 6,500	3	11	6
6,501 to 7,000	4	2	6
7,001 to 7,500	4	4	7
7,501 to 8,000	4	6	7
8,001 to 8,500	4	7	7½
8,501 to 9,000	4	11	7½
9,001 to 9,500	5	1	8¼
9,501 to 10,000	5	3	8¼
10,001 to 10,500	5	3	9
10,501 to 11,000	5	5	9
11,001 to 11,500	5	6	10
11,501 to 12,000	5	8	10

All warps containing one color only 70 yards long constitute one cut.
All warps containing more than one color 60 yards constitute one cut.
Half cuts and under, 6 pence off cut prices; over half cuts claim cut prices.
One shilling for cutting warps
All warps containing more than one color 2 pence per color per cut.
Extra is paid, excepting "splits," where two colors are on one pair of rods.
For splits they will be paid for as one color.
Pattern slaying will be paid 3½ pence per 1,000 ends.
Winding on, 4 pence for narrow looms under 20 yards and 7 pence for broad.
Time rate, 6 pence per hour.

STANDARD PIECEWORK PRICES.

The foregoing actual piecework prices from a large Leeds fine-worsted mill may be taken as typical of that class of work in that section. For the Bradford district the Bradford City Technical College has compiled the following as representing the standard practice for the above work:

Bradford dressing and twisting-in list.

[Average wage for dressing 70 yards of warp, end and end.]

Ends in warp:	s.	d.
1,801 to 2,200	2	6
2,201 to 2,600	3	0
2,601 to 3,000	3	6
3,001 to 3,400	4	1
3,401 to 3,800	4	8
3,801 to 4,200	5	3
4,201 to 4,600	5	10
4,601 to 5,000	6	7
5,001 to 5,400	7	2
5,401 to 5,800	7	10
5,801 to 6,200	8	6

Extras: For each above two colors, 3½ pence per color.
Time work: Six and one-half pence per hour.

Bradford price list for looming and twisting.

Twisting:
In twisting frame, 5 pence per 1,000 ends.
In twisting frames (stripes), 5½ pence per 1,000 ends.
At loom, 6 pence per 1,000 ends.
Sleying: Four pence per 1,000 ends.

Looming (drawing-in and sleying) per 1,000 ends:	s.	d.
Straight draft up to 14 shafts	1	0
Straight draft 14 to 20 shafts	1	3
Straight draft over 20 shafts	1	6
All drafted styles	1	6
Jacquards	1	3

Extra rollers or beams, 1 shilling per beam or roller.
Time work: Six pence per hour.

EXPLANATORY DEFINITIONS.

It is hardly necessary to explain the above terms, but to avoid any chance of mistake will say by "twisting" is meant the work done by the "twister-in" man in twisting each thread of a new warp with the corresponding threads of the old warp before it has been entirely run out of the heddles and reed. "Looming" is starting a new set of warp threads through clean heddles and reed; drawing the warp threads with a reed hook (usually called heald-hook in England), being known as "drawing-in," and then drawing these threads on through the reed, being known as "sleying." Warps are spoken of as "sleyed" 1, 2, 3 or more ends according as there are 1, 2, 3 or more ends drawn together through each opening or "split" (dent) in the reed. The term "dressing" has no reference to sizing (there is very little sizing done in the Bradford district), but refers to the work of running the warp as already made with a certain definite number of threads on to the loom beam in regular order.

The specific number of ends required for a specific warp are usually collected together on a horizontal "Bradford mill" in the Bradford district, or on a vertical "Scotch mill" in the other wool districts, and then unwound from the mill into a ball. This ball of warp is then taken by the "dresser," and by running up, over and under cross beams of wood is spread out evenly under tension and wound on the loom beam. In "beam warping" as used in the cotton trade the "dressing" is done away with, and this system is beginning to be more largely used in the woolen trade.

SIZING, DYEING, AND FINISHING.

In the cotton trade warps are nearly always sized before weaving to prevent chafing in the weaving, and very often they are heavily sized, sometimes up to 200 per cent of their weight, by adding weighting materials, such as China clay, etc., to decrease the cost of manufacture for cheap goods. In the worsted trade any sizing that is put on could only be for the first reason, as the size materials will necessarily all be washed out in the scouring, dyeing, and finishing processes to which the cloth is subjected after manufacture. Ordinarily in the Yorkshire worsted trade there is no sizing used whatever, either for the wool warp or for the cotton warps used in the Bradford stuff industry, except for warps that are found to be too tender to weave without it. Woolen warps as used in the Leeds district are nearly always sized, but it has been found that good worsted, good cotton, and reasonably long-plied "spun" silk warps weave all right without size.

All the dyeing and finishing operatives are ordinarily paid by the hour or week. The girl menders are usually paid 4 pence (8 cents) an hour. The girl "burlers" who inspect the cloth and remove small defects are usually paid by the hour, but in a good many cases by the piece. Their remuneration varies considerably, according to the goods and the care with which the work has to be performed, but an idea of their wages can be obtained from the fact that on men's fine worsteds they will get from 9 to 11 pence (18 to 22 cents) per 58-yard cut. On cheaper goods they will average about 4 pence an hour. The male "miller" and the "cloth scourer" will average about 5 pence (10 cents) an hour. Milled cloth ready for finishing is called here "balk." In the case of ordinary materials that call for no special skill, scourers, raisers, steamers, etc., will not make more than 20 to 22 shillings ($4.80 to $5.28) per week. On finer classes of work their wages will run up to as high as 30 shillings ($7.20) a week. The highest paid finishers are usually the foremen fullers and press setters, who will make from 31 to 37 shillings ($7.44 to $8.88) a week.

The dyers are paid by the week, but as they are strongly organized their wages in each district are much more uniform than that of other classes of workers. At the present time (October 21) their average wages in the Bradford district are about 26 shillings ($6.24), in the Leeds and Halifax districts 25 shillings ($6), and in the country districts 24 shillings ($5.76) per week.

Dyeing and finishing are sometimes carried on in the same works as the actual manufacture, but are usually done by special firms. The average commission prices for dyeing and finishing in the Bradford district, as compiled by the Bradford Technical College, are as follows:

Prices for dyeing and finishing.

Under 9 ounces per yard, all-wool (plain finish): Black, 3¾ pence; colors, 4½ pence per pound (grey).

Over 9 ounces per yard, all-wool (plain finish): Black, 4 pence, colors, 5½ pence per pound (grey).

Figured mohairs: Not over 50 inches wide, 50 yards long, and 20 pounds, dyeing black, 5 shillings 6 pence per piece.

Linings and Italians: Not over 60 inches wide, 54 yards long, and 28 pounds (grey), dyeing black, 7 shillings per piece.

Finishing and degumming plain silks: Twenty-seven inches wide, 1¼ pence per yard; 28 to 36 inches wide, 1½ pence per yard.

Finishing and degumming brocades: Twenty-seven inches wide, ¾ pence per yard; 28 to 36 inches wide, 1 pence per yard.

Silk handkerchiefs: About 6 pence per dozen.

Prices for finishing only.

All wool (plain finish), 1½ pence per pound (grey); milled or vicuna finish, 2 shillings 6 pence per piece (extra); "Pirle" finish, 1 pence per yard (extra); "proofing," 1½ pence per yard (extra); "stove white," 3 shillings per piece over color price.

YORKSHIRE WOOL WORKERS.

Of 1,029,253 persons employed in textile factories in Great Britain in 1901, according to the census of that year, 522,623 were working in cotton factories and 259,909 in worsted, woolen, and shoddy factories. Of these latter 86,266 were employed in the Bradford district, 54,066 in the Huddersfield district, 25,861 in the Halifax district, and 20,176 in the Leeds district. The next largest groups of wool workers were shown as 11,532 in southeast Scotland, 9,892 in the Rochdale section of Lancashire, 7,268 in the Worcester section, and 7,156 in the Bristol section of the west of England. It is seen that the bulk of the wool workers of Great Britain are in the West Riding of Yorkshire—187,235 out of a total of 259,909—with smaller groups in Scotland, the west of England, and Lancashire.

Wool manufacturing is the main industry of the West Riding, and one-twelfth of all the male workers, and over one-fourth of all the female workers, are engaged in this industry, while in Bradford itself the industry takes one-fifth of all the male workers and nearly half of all the female workers. About one-third of the total population of the West Riding is directly or indirectly dependent on this industry.

NUMBER AND SEX OF OPERATIVES.

Of the total operatives employed in wool manufacturing in Great Britain three-fifths are females and only two-fifths males. The arrangement of the operatives according to sex and age in 1901 was as follows:

	Male.	Female.	Total.
Children, 12 to 14, half-timers	3,722	3,753	7,475
Young persons, 14 to 18	19,266	35,117	54,383
Persons above 18	83,610	114,441	198,051
Total	106,598	153,311	259,909

The government figures for the total number of operatives employed in wool manufacturing in Great Britain showed 301,556 in 1890 and 284,441 in 1896, and the above 259,909 in 1901, which are the latest.

These figures would seem to show a decline in the industry, which is probably true for the period 1890 to 1901, though others claim there was no decline but instead a small advance, for the following reasons: The persons over 20 employed in 1890 were 161,394, and in 1901 they were 160,999, about the same, so that the decrease was almost entirely of half-timers and other children. In 1890 the half-timers numbered 22,806 while in 1896 they were only 12,505, and in 1901 only 7,475. Owing to stricter regulations their number seems to be steadily decreasing. Another point is that machinery in being continually improved, so that the productive efficiency of each operative is greater. Another very important fact to be considered is the increasing proportion of foreign materials, especially cotton, that is now used in both woolen and worsteds, but especially the latter. In Yorkshire there is now a comparatively small proportion of the wool manufactures that are made of wool only. Taking all these facts into consideration it would yet seem that from 1890 to 1901 there was no progress in this industry, but since 1901 there has been a steady progress up to the latter part of 1907, when the world began to suffer from a financial crisis.

There are no figures of production in the United Kingdom, but the industry can be fairly well judged by the exports. The exports of manufactures of wool of all kinds from Great Britain in 1890 was $141,984,950, and in 1901 this had fallen to $114,355,836, but in 1907 it rose to $185,603,950. Though there are no figures in regard to the total number of operatives since 1901, it is clear that with this great increase in exports, even though there is a larger and larger proportion of other materials included, there must have been a considerable increase in the number of hands needed to run the wool factories.

FEMALE OPERATIVES PREDOMINATE.

Leeds is the sixth largest city in the United Kingdom and is the commercial and industrial center of the West Riding for everything but wool, in which it is exceeded by the smaller town of Bradford. Bradford has become the chief manufacturing and selling center of the wool trade of the Kingdom, and in 1900 the British Association Handbook computed that "five-sixths of the wool manufactured or partly manufactured in this country is at some stage the subject of a bargain in some Bradford merchant's warehouse." Considering only the city of Bradford the workers in wool and worsted according to the last census are as follows:

Process.	Under 15.		15 to 24.		25 to 44.		45 and up.		Total.	
	Male.	Female.	Male.	Female.	Male.	Female.	Male.	Female.	Male.	Female.
Sorting	5	2	312	11	820	20	565	12	1,702	45
Combing	41	22	1,000	962	1,456	1,020	689	185	3,186	2,189
Spinning	2,014	2,910	1,159	5,883	644	1,591	262	220	4,079	10,604
Weaving	209	268	674	5,816	1,379	5,548	820	1,354	3,082	12,986
Other workers	388	136	2,091	807	2,912	601	1,474	121	6,865	1,665
Total	2,657	3,338	5,236	13,479	7,211	8,780	3,810	1,892	18,914	27,489

It is seen that while the men predominate in the beginning and end of the manufacture, that is in the sorting and finishing processes, the great bulk of the operatives in the intermediate manufacturing processes proper, combing, spinning, and weaving, are

women. One-sixth of the women in the wool industry, say some 19,000, are wives or widows. Over 12,000 of these are weavers, but in proportion to the total number of women employed the largest number is in the combing industry. As has been shown, the number of children from 12 to 14, the "half-timers," are steadily decreasing, and leading authorities say that the number of married women are decreasing also, but there are no figures to corroborate this. Of the four main textile centers of Yorkshire the largest percentage of children under 14 is to be found in Halifax, and then comes Bradford, Huddersfield, and Leeds in the order named. The largest percentage of wives and widows is to be found in the Bradford industry, which is followed by Leeds and then Huddersfield and then Halifax.

WAGES AT LEEDS AND YORKSHIRE.

Besides its regular woolen and worsted manufacturing, Leeds is noted as a great center for ready-made clothing. The 1901 census showed that among persons employed in "nontextile factories" in Leeds there were 20,220 classed as being in the clothing business, the great bulk of these being women and girls. In this industry the men cutters get $6.80 to $8.25 a week, the women machine sewers $2.67 to $3.89, and the women finishers $1.94 to $3.40 a week. The wages of operatives in the woolen and worsted factories have been treated elsewhere, but the wages of full-timers run from 8 to 30 shillings ($1.94 to $7.29) a week; a few up to 35 shillings ($8.50). Over $8.50 a week is very rare even for the most skilled workers.

As a rule the Yorkshire wool worker gets more than the French wool worker, but in some parts of the industry the French worker gets the higher wage. The English wool worker, however, is better off, for even where he does not get any higher wages the purchasing power of those wages is greater, for both food and clothing are cheaper in Yorkshire than in France. On the other hand, the Yorkshire wool worker gets smaller wages than the Lancashire cotton worker, while according to recent investigations by the Board of Trade the charges for both rent and food are higher in Yorkshire than in Lancashire.

EMPLOYMENT IRREGULAR.

Employment in all branches of the wool industry is more or less irregular, for not only are there good and bad years, but the fluctuations of the demand for various kinds of wool manufactures sometimes throw a whole locality making some specialty into the depths of distress, and at the same time perhaps raise another to the heights of prosperity. This changing demand some times acts only between towns making various specialties and at others affects a whole country. When there is a great demand for very soft draping goods, France is prosperous and England can hardly keep her mills going, while, when the demand is for firmer worsteds and tailor-made goods, England will be prosperous and perhaps France losing ground. Sometimes woolen goods are in demand and then worsteds. One season the all-wool goods may bring in the most profit and another season, with high-priced wool, only the sections making mixed goods can show any profit at all. The wool industry is thus subject to many fluctuations, and in that sense is not a stable industry as are, for instance, certain branches of the cotton trade making staple cloths that are in demand year *in and year out.* In the wool trade there have to be new styles

gotten out for the summer and winter, and the demand of the public for variety is growing all the time, so that the mills have to employ a larger number of men in their designing and sales departments, which adds to the cost.

All of this, with many other details that could be enumerated, especially the fact that in some lines cotton goods for underclothing, etc., now enter into competition with wool, directly affects the conditions of employment of the wool operatives. The combers are perhaps the ones most affected. Combing mills always try to run night and day, but there is scarcely a year but what not only night work has to be discontinued but even day work interrupted for certain periods. Only men can be employed at night according to the law, and the Bradford labor organizations say that night combers do not average three and one-half nights a week.

LIABILITY TO DISEASE.

The work in woolen and worsted mills is, on the whole, a healthy occupation, but wool sorters have to face the danger of anthrax. The combers work in a high temperature, which makes night work dangerous sometimes to health on account of the extremes of heat and cold to which they may be exposed, and rag pullers frequently get "shoddy fever." Anthrax is a most dangerous disease, but is usually only to be dreaded by those who sort mohair, camel's hair, etc., and in these cases the Government has enacted strict rules in regard to preventive measures to be adopted. In shoddy manufacturing there is no danger of disease—at least there is no record of any disease contracted by the workers—except that the operative who watches the rag shaking and pulling machines sometimes gets influenza, or "shoddy fever," as it is called, from the irritation of the dust and wool impregnated atmosphere getting in his throat.

LABOR ORGANIZATIONS.

In regard to organizations of operatives, these are very rare in Yorkshire. The Lancashire cotton operatives are very strongly organized, and it is partly due to this fact that they get better wages than the Yorkshire wool workers. The larger portion of the Yorkshire workers are women, but while there are nearly 100,000 women in unions in Lancashire, there are scarcely 1,000 women in unions in the Yorkshire trade. There are several reasons for this lack of unions among the wool workers. In the first place, the Lancashire workers are enabled to organize by reason of the fact that there are great bodies of workers at one center, and in each mill there are large bodies of workers in the same line. In Yorkshire the industry is more scattered, and the mills being smaller the men are more separated. In most rooms the men are differentiated from the women by the fact that the women form the bulk of the common workers, while the men are in positions of trust, such as overlookers, loom fixers, etc., or working on a different line of machines. The overlookers have a strong union of their own, as also have the dyers, for the dye department of the mill is a place where there are a number of men working side by side. The men workers outside of these are usually in the minority in the rooms in which they work, and, being scattered in different mills, they do not combine, and where the

men are not combined it is always difficult to get the women to combine. There is also jealousy between every neighboring town in Yorkshire and between every neighboring mill, and this fact is one thing that tends to prevent combination among either employers or employees. The unions that have been formed among the operatives, therefore, are not strong, and their main concern usually is in friendly society work and mutual aid, as they are rarely strong enough to initiate any general strike for higher wages.

For wool sorters there is usually required an apprenticeship, but the period of apprenticeship is decreasing and is now not more than two years. There is also usually some apprenticeship to be served before becoming a loom fixer or overlooker. For the other branches of the industry there is no formal apprentice system, but the hands start in young and gradually work up from a lower-paid job to a higher.

FACTORY LAWS.

The following summary of factory laws as affecting the woolen and worsted industries in various countries is taken from a recent book published by Prof. J. H. Clapham, but was originally published by the Office International du Travail at Bâle:

	Great Britain.	France.	Germany.	Holland.
DAY WORK.				
Number of classes of work people affected by the laws.	2	3	3	2.
Minimum age of workers	12	12	13	12.
Class 1:				
Age limits	12–14	12–16	13–14	12–16.
Maximum day's work	6½ hours; 5 Saturday.	10 hours	6 hours	11 hours.
Maximum week's work	32½ hours	60 hours	36 hours	66 hours.
Class 2:				
Includes	Women and young persons (14–18).	Young persons (16–18).	Young persons (14–16).	Women over 16.
Maximum day's work	10 hours; 5½ Saturday.	10 hours	10 hours	11 hours.
Maximum week's work	55½ hours	60 hours	60 hours	66 hours.
Class 3:				
Includes		Women above 18.	Women above 16.	
Maximum day's work		10 hours	11 hours	
Maximum week's work		60 hours	65 hours	
Grown men:				
Maximum day's work	Not laid down.	10 hours; when no women or children employed men may work 12 hours a day	Not laid down.	Not laid down
Maximum week's work	Not laid down.	60 hours	Not laid down.	Not laid down.
NIGHT WORK.				
Legal definition of	9 p. m.–6 a. m.	9 p. m		
Is it forbidden for children and young persons?	Yes	Ye		
Is it forbidden for women?	Yes	Ye		
From what age may men work at night?	18	18		
Legal holidays	Sundays and 5 other days.	S		

	Belgium.	Italy.	Switzerland.	Massachusetts.
DAY WORK.				
Number of classes of work people affected by the laws.	3	2	2	2.
Minimum age of workers	12	12	14	14.
Class 1:				
Age limits	12-14	12-15	14-16	14-16.
Maximum day's work	11½ hours	11 hours (with exceptions).	11 hours	Not laid down.
Maximum week's work	67½ hours	66 hours (with exceptions).	65 hours	58 hours.
Class 2:				
Includes	Young persons (14-16).	Women over 15.	All over 16	All over 16.
Maximum day's work	11½ hours	12 hours	11 hours	Not laid down.
Maximum week's work	67½ hours	72 hours	65 hours	58 hours.
Class 3:				
Includes	Women 16-21			
Maximum day's work	11½ hours			
Maximum week's work	67½ hours			
Grown men:				
Maximum day's work	Grown men are not dealt with nor are grown women.	Not laid down.	11 hours	Not laid down.
Maximum week's work	do	Not laid down.	65 hours	Not laid down.
NIGHT WORK.				
Legal definition of	9 p. m.-5 a. m.	8 p. m.-6 a. m. summer, 9 p. m.-5 a. m. winter.	8 p. m.-6 a. m. summer, 9 p. m.-5 a. m. winter.	10 p. m.-6 a. m.
Is it forbidden for children and young persons?	Yes	Yes	Yes	Yes.
Is it forbidden for women?	No	Yes	Yes	Yes.
From what age may men work at night?	16; women from 21.	15	18	16.
Legal holidays	52 days a year.	52 days a year.	Sundays and a maximum of 8 other days.	Sundays and 7 other days.

DWELLINGS OF WAGE-WORKERS.

Throughout Yorkshire the typical workmen's dwellings are built in what is called the "terrace" style—that is, in straight rows of two-story brick or stone buildings, usually on sloping ground, so that each four-room section in the row is "stepped" (raised) up a few feet above that of the one next below adjoining. There is little variation, and throughout Yorkshire this type is almost universal. In Saxony and other sections of the Continent, also in parts of Scotland, the prevalent type is four or five story barrack tenements built around the four sides of the block. In such cases there are two to four doors opening on each landing. There is little privacy, and as it is troublesome for the small children and the old people to go up and down the stairs they get little outdoor exercise. This type of building is very rare in England, as each worker wants his own separate entrance, and workmen's dwellings are rarely over two stories high. There are no detached buildings, however, so we see these long rows of uniform dwellings, usually straight but at other places winding in curves up and down the slopes. Figures 1 and 2 (pp. 63 and 65) show typical Bradford streets and houses inhabited by operatives from the worsted factories, while figure 3 (p. 67) shows the type of older streets in Bradford with houses inhabited by the poorer paid classes of operatives.

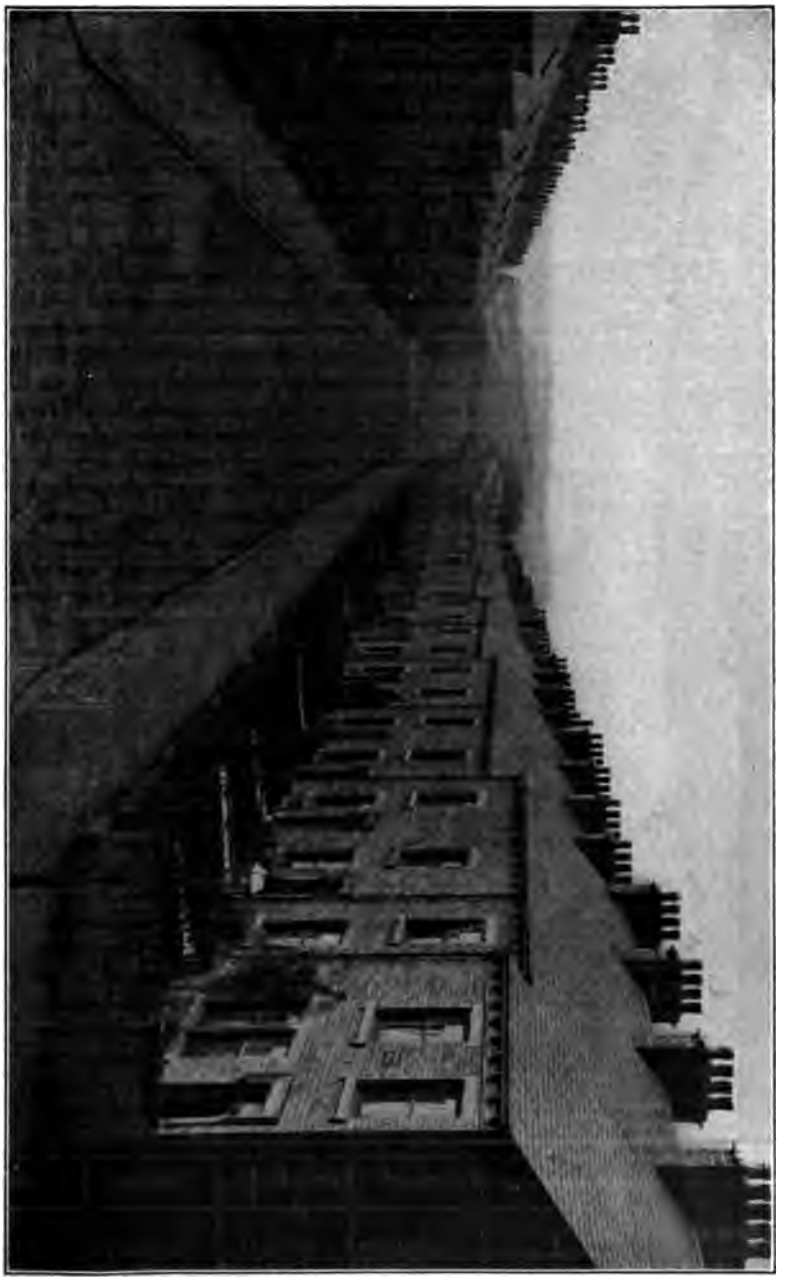

FIG. 1.—Typical Bradford street.

The houses composing these terraced rows are usually one or the other of the two following classes:

First, "through" houses, consisting of kitchen, sitting room and two or three bed rooms facing a front street 42 feet wide. They are built in rows of eight usually, and between each pair of front streets is a back street of 15 feet, separating the back yards from those of the next row of houses. Each house in the row is only one room wide, usually 12 feet. On the ground floor is the living room, entered direct from the street, and behind this the scullery. On the first floor above are two bedrooms, and if there is an attic another bedroom in that. The size of the living room and of the large bedroom is usually 12 by 15 feet, and 11 feet high, or 12 by 11 by 9 feet, and of the smaller bedroom about 10 by 7 feet 6 inches and 9 feet high. Almost all houses have small basements and in these are provided a pantry, accommodation for coals, and sometimes a wash kitchen. Such houses rent from $1.22 to $1.94 a week.

The second type of houses is built also in rows but back to back, and each consists of either a living room and a large and small bedroom, or, as is usually more common, of a living room on one side of the door and a scullery on the other, a bedroom over each, and usually a third attic bedroom with dormer window. These are built in blocks of eight, and rent for 97 cents to $1.40 a week. They also usually have a small cellar used as pantry, space for coal, etc. These houses are only one room in depth. There is no through draft from back to rear, and no back yard in which to deposit dirt, which is an advantage in the poorer quarters of the town. This back-to-back style of house is not as sanitary or convenient as the "through" type, and in many sections of England is forbidden but it is the predominant type in Yorkshire.

DWELLING HOUSES COMPARED.

As a rule the English workman has a good deal more living room than the continental workman. On the Continent, in most places where the tenement-house system flourishes, two rooms constitute the ordinary requirements of a worker and his family, while an English worker with the same sized family will have three, four, or five rooms, four rooms being about the average. At Chemnitz the typical operative pays 3 marks (71 cents) rent a week for two rooms in a big tenement, and at Bradford the typical operative pays 5 shillings ($1.21) for a four-room section in a back-to-back row of two-story terrace houses. The rent per room is a little less to the Englishman, and his home life is more private, as he enters direct from the street instead of from a landing used by two or three other families. The following table shows the present range of rents in the four leading wool towns of Yorkshire in dollars per week:

Houses.	Bradford.	Huddersfield.	Halifax.	Leeds.
Back-to-back:				
Two-room	$0.73-$0.97	$0.73-$0.91	$0.55-$0.73	$0.73-$0.85
Three-room	.97- 1.21	1.09- 1.35	.73- .90	.85- 1.09
Four-room	.97- 1.35	1.22- 1.40	.97- 1.40	1.09- 1.46
Five-room	.....	1.70- 2.18	1.22- 1.58	1.22- 1.58
Through:				
Four-room	1.22- 1.58	.....	1.46- 1.94	.....
Five-room	1.40- 1.82	.....	1.46- 2.06	1.58- 1.70

FIG. 2.—Typical Bradford street.

In the typical back-to-back terraced style of dwellings the average rent per room is therefore about 30 cents per room a week, and about 35 cents per room a week in the case of the through houses varying according to the number of rooms to the house, the town, and the location.

Considering the total population of the four main towns the census of 1901 showed the dwelling conditions to be as follows, the figures representing percentage of total population inhabiting dwellings of one to five or more rooms, respectively:

Town.	Population.	1 room.	2 rooms.	3 rooms.	4 rooms.	5 rooms or more.
Bradford	279,767	1.2	13.6	27.4	20.8	37.0
Huddersfield	95,047	2.1	12.9	26.5	20.9	37.6
Halifax	104,936	2.2	18.3	17.3	17.6	44.6
Leeds	428,968	.4	9.5	16.0	25.0	49.1

It is seen that one-half to three-fourths of the population inhabit houses of four to five rooms. The rents given above include all rates. As a rule out of 6 shillings 6 pence rent the rates will amount to about 2 shillings 6 pence in the town. The rents, wages, and food costs are higher in Huddersfield than in any of the other Yorkshire towns. It is usually considered by economists that wages follow rents, but it is sometimes difficult to say which is cause and which effect. The Huddersfield question may be influenced by the fact that the factories there employ a much larger proportion of male labor than is the case in any of the other wool-manufacturing sections.

COST OF FOOD.

Food is higher in Scotland than in England, but is higher in Yorkshire than in Lancashire. For instance, at Dundee a 4-pound loaf of bread costs 6 pence (12 cents), but at Bradford it is only 5 pence, and at Manchester it is only 4½ pence. This proportion does not hold good in regard to all articles, but shows the general trend of the food costs. Of the Yorkshire wool towns Huddersfield is the highest. Bradford prices are about the average for the wool section.

In Yorkshire, as throughout the United Kingdom, flour, potatoes, etc., are sold by the half-stone of 7 pounds, while bread is sold by the 4-pound loaf. Present prices (October 21) at Bradford run about as follows in United States currency:

Article.		Cents.
Tea	per pound	40.0
Sugar, granulated	do	4.3
Flour	do	2.3
Potatoes	do	.8
Bread	do	2.5
Butter	do	24.3
Cheddar cheese, American	do	13.5
Beefsteak	do	19.0
Bacon, roll	do	16.0
Mutton, leg	do	19.0
Pork, leg	do	17.0
Eggs	per dozen	26.0
Milk	per quart	6.0

FIG. 3.—Older street in Bradford.

Paraffin oil sells for 15 cents a gallon and coal sells by the hundredweight of 112 pounds for 22 cents.

Many of the operatives belong to cooperative societies, and these get their groceries and coal cheaper than the above by about 15 per cent. The largest of these cooperative societies in Bradford has a membership of over 20,000.

PLAIN WORSTED COATINGS.

PARTICULARS OF PLANT AND COSTS FOR THE PRODUCTION OF THE CLOTH AS A FINISHED MATERIAL.

In a British plant of one hundred 84-inch box looms, the following details have been worked out, covering all the processes and expenses in producing a certain plain worsted coating, which is pictured in illustration following:

Cloth to be produced [as per sample in the Bureau of Manufactures] is woven 70 inches wide in loom, and finishes 60 inches wide. Seventy yards of warp produces 61½ yards (37 inches trade yards) finished cloth. Cloth is made with 78 ends of 2/44s worsted warp

FIG. 4.—Plain worsted coating.

per inch, and 72 picks 1/20s worsted weft per inch. Cloth weighs 16.15 ounces per yard (37 by 60 inches). Each piece requires 31½ pounds warp and 32½ pounds weft, or a total of 64 pounds yarn.

The production of 100 looms running at 125 picks per minute, fifty-four hours per week, fifty weeks per year, allowing for 30 per cent stoppage, 72 picks per inch, 68 yards per piece woven, will figure as follows in number of pieces per annum:

$$\frac{100 \text{ by } 125 \text{ by } 60 \text{ by } 54 \text{ by } 50 \text{ by } 70}{100 \text{ by } 72 \text{ by } 36 \text{ by } 68} = 8{,}042, \text{ say } 8{,}000.$$

The weight of yarn required for 8,000 pieces will be—

	252,000 pounds 2/44s worsted warp.
	260,000 pounds 1/20s worsted weft.
Total	512,000 pounds yarn.

The weight of top required, allowing 7½ per cent waste in spinning, will be about 553,500 pounds. To produce this amount of top the

greasy wool required, figuring on a yield of 52 per cent, and a tear of 8 parts top to 1 part noil will be obtained as follows:

553,500 pounds top.
69,200 pounds noil.

622,700 pounds clean wool or about 1,200,000 greasy wool.

Very few English worsted mills are self-contained; that is, very few contain the whole series of processes from greasy wool to finished cloth. Usually the manufacturing is divided up among a large number of separate firms, making a specialty of their own department. Thus, there is (1) the wool buyer, (2) the top maker, (3) the worsted spinner, (4) the weaver, (5) the dyer and finisher, with the merchant or the weaver as the central agent in the cloth manufacture. Naturally, each of these firms has a separate staff for administration and selling, and makes its own charges for profit and financing. If a mill could make only a few styles of goods it would be more economical to operate a complete plant, but worsteds are so affected by the vagaries of fashions that the individualization of processes is usually preferable.

USUAL TRADE CHARGES.

In the following notes I will first figure the cost of making this cloth according to the usual trade charges for commission work, and will then figure out the cost of equipment and of operation of the various departments:

COST OF TOP.

	£	s.	
100 pounds P. P. (Port Philip) wool, at 11½d. (23 cents) per pound. Add for carriage, etc., about ½d. (say 1 cent) per pound, which makes total cost per pound wool about 1s. (24.3 cents), and for 100 pounds	5	0=	$24.33
Yields 6 pounds noil, at 1s. 4d., or 32.3 cents a pound		8=	1,94
Therefore 46 pounds top, at 2s., or 48.6 cents a pound	4	12=	22.39

Add for combing 2d., or 4 cents, a pound; therefore cost per pound top is 2s. 2d., or 52.6 cents, a pound.

COST OF 2/44s WORSTED YARN.

	£	s.	d.	
100 pounds top, at 2s. 2d. (52.6 cents) per pound	10	16	8=	$52.71
Yield 7½ pounds waste at 8d. (16 cents)		5	0=	1.21
	10	11	8=	51.50
Therefore 92½ pounds, at 2s. 3½d. (55.6 cents) per pound	10	12	0=	51.58

Add for spinning 4½d., or 9 cents, a pound; therefore cost per pound is 2/44s=2s. 8d., or 66.6 cents.

COST OF 1/20s WORSTED YARN.

	£	s.	d.	
100 pounds top, at 2s. 2d. (52.6 cents) per pound	10	16	8=	$52.71
Yields 7½ pounds waste, at 8d. (16 cents) per pound		5	0=	1.21
	10	11	8=	51.50
Therefore 92½ pounds yarn, at 2s. 3½d. (55.6 cents) per pound	10	12	0=	51.58

Add for spinning 2d., or 4 cents, per pound; therefore cost per pound of 1/20s=2s. 5½d., or 59.6 cents.

COST OF CLOTH.

	£	s.	d.	
31½ pounds 2/44s worsted warp, at 2s. 8d. (64.6 cents) per pound	4	4	0=	$20.44
32½ pounds worsted weft, at 2s. 5½d. (59.6 cents) per pound	4	0	0=	19.47
Warping and beaming		1	6=	.36
Weaving		15	0=	3.65
Mending		3	6=	.85
Scouring and finishing		9	6=	2.31
Piece dyeing		12	6=	3.04
Warehouse and selling		6	0=	1.46
Finances, etc		12	0=	2.92
	11	4	0=	54.50
61½ yards, at 3s. 8d. (88.9 cents)	11	5	6=	54.67

Therefore cost per yard is 3s. 8d., or 88.9 cents.

The selling price at the mill was 96 cents a yard, which is about 95 cents a pound.

The wool at various stages of manufacture (including the noils and waste which are sold to a woolen manufacturer) would have the following values and the following would be the duty on same:

	Price per pound in Huddersfield.	Tariff paragraph.	Equivalent advalorum duty.
	Cents.		*Per cent.*
Greasy Port Philip wool	24.3	357	45.3
Noils	32.3	362	61.9
Scoured wool	48.6	354	67.9
Tops	52.6	366	133.6
Waste	16.0	361	187.5
Warp yarn 2/44s	66.6	365	97.8
Weft yarn 1/20s	59.6	365	104.6
Finished cloth	95.0	366	101.3

COST OF EQUIPMENT AND OPERATION.

We will now figure on the detailed cost of equipment and detailed costs of operation of the different departments to produce 8,000 pieces per year of the 16.15-ounce (per yard 37 inches by 60 inches) plain worsted coating. The departments will be as follows: (1) Wool combing; (2a) spinning for 2/44s worsted warp; (2b) spinning for 1/20s worsted weft; (3) warping and beaming; (4) weaving; (5) perching, mending, and knotting; (6) scouring and finishing; (7) piece dyeing; (8) warehouse and selling; (9) office.

(1) WOOL-COMBING PLANT.

[Estimate by Taylor, Wordsworth & Co., Leeds, to produce 4,000 pounds finished tops per day of ten hours.]

Capital expenditure:

1 Malard steeping machine.
4 wool-washing machines (1 4-bowl set) 36 inches wide.
12 cards, each producing 360 pounds per day of ten hours. Card clothing for these 12, at £75, £900.
1 grinding frame.
2 7-cylinder hot-air backwashers, each delivering 2,000 pounds per day of ten hours.
2 first preparers.
2 second preparers.
1 winding frame.

Capital expenditure—Continued.

10 Noble combing machines, each producing 400 pounds per day of ten hours.
6 first finishers.
6 second finishers.
1 4-cylinder willey for card waste.

Total cost of above combing plant, £12,000, or $58,398; total power required, 100 indicated horsepower; total space required, 15,000 square yards.

Labor:	£	s.	d.		
General wages per week	23	9	6	=	$114.23
Wages mechanic	2	0	0	=	9.73
Wages pin setter	1	15	0	=	8.51
Wages two men on Malard steeper	2	10	0	=	12.16
Total	29	14	6	=	$144.63

	Per year.		
Departmental costing:			
Machines, interest and depreciation (14 years) on £11,000, at 4½ per cent	£ 1,076	s. 0	=$5,236.35
Cards, interest and depreciation (6 years) on £1,000, at 4½ per cent	194	0	= 944.10
Rent, 1,500 square yards, at 3s. 6d. per square yard	262	10	= 1,277.45
Motive power, 100 indicated horsepower, at £5	500	0	= 2,433.25
Repairs	120	0	= 583.98
Rates, taxes, lighting, and insurance	500	0	= 2,433.25
Auxiliary supplies	250	0	= 1,216.63
Steam for combs, washers, etc	90	0	= 437.99
Water for washers and steeper	80	0	= 389.32
Miscellaneous expenses	100	0	= 486.65
Wages, £29 14s. 6d. for 50 weeks	1,486	5	= 7,232.83
Wages, £4 for 52 weeks	208	0	= 1,012.23
Total	4,866	15	=23,684.03

Productive capacity=4,000 by 5½ by 50, or 1,100,000 pounds per annum.
Cost per pound=£4,866–15÷1,100,000=1.07d., or 2.14 cents per pound.

The trade commission charged for combing is 2d. (4 cents) per pound, which must include profits, administration, finance, and selling charges.

(2[a]) PLANT FOR 6,000 POUNDS PER WEEK 2/44S—BOTANY—OPEN DRAWING.

Capital expenditure:	£	s.		
4 revolving ball creels for 12 balls, at £11	44	0	=	$214.13
4 double can gill boxes, at £26	104	0	=	506.11
6 2-spindle gill boxes, at £26	156	0	=	759.17
2 6-spindle drawing boxes, at £25	50	0	=	243.33
2 8-spindle drawing boxes, at £30	60	0	=	291.99
2 12-spindle first finisher, at £36	72	0	=	350.39
6 12-spindle finishers, at £36	216	0	=	1,051.16
9 24-spindle reducing frames, at 30s	324	0	=	1,576.75
24 32-spindle roving frames, at 27s	1,036	16	=	5,045.58
28 cap spinning frames, 160 spindles each, at 12s	2,688	0	=	13,081.15
12 cap twisting frames, 160 spindles each, at 11s. 9d.	1,128	0	=	5,489.41
Miscellaneous expenses, cans, belting, spools, etc	500	0	=	2,433.25
Total	6,378	16	=	31,042.42

Floor space required, 1,986 square yards; power required 189 indicated horsepower.

	Per week.			
Labor:	£	s.		
1 can gill tenter		12½	=	$3.04
2 spindle gill tenters, at 12s. 6d	1	5	=	6.08
2 drawing-box tenters, at 12s. 6d	1	5	=	6.08
4 finisher tenters, at 12s	2	8	=	11.68
3 reducer tenters, at 12s	1	16	=	8.75
8 rover tenters, at 12s	4	16	=	23.35
1 jobber tenter		12	=	2.92
1 overlooker tenter	1	12	=	7.78
28 spinners, at 10s	14	0	=	68.13
14 doffers, at 8s. 6d	5	19	=	28.95
1 jobber		11	=	2.67
2 takers-off, at 10s	1	0	=	4.86
2 setters, at 9s. 6d		19	=	4.62
1 sweeper		7	=	1.70
1 overlooker	1	12	=	7.78
24 twisters, at 11s	13	4	=	64.23
8 doffers, at 8s. 6d	3	8	=	16.54
1 jobber lad		11	=	2.67
2 takers-off, at 10s	1	0	=	4.86
2 setters, at 9s. 6d		19	=	4.62
1 overlooker	1	12	=	7.78
	59	8½	=	289.09
Share of manager's wages, at £6	4	0	=	19.47
Total	63	8½	=	308.56

Worsted spinning, 2/44s.

	Per year.			
Departmental costing:	£	s.		
Interest and depreciation (10 years) on £6,500, at 4½ %	814	11	=	$3,964.00
Rent, 2,000 square yards, at 3s. 6d	350	0	=	1,703.27
Motive power, say 200 indicated horsepower, at £5	600	0	=	2,919.90
Repairs	50	0	=	243.32
Lighting	120	0	=	583.98
Rates, taxes, and insurance	250	0	=	1,216.62
Materials	70	0	=	340.66
Miscellaneous expenses	30	0	=	146.00
Wages, 50 weeks, at £59–8–6	2,971	5	=	14,454.50
Wages, 52 weeks, at £4	208	0	=	1,012.24
Total	5,463	16	=	26,584.49

Production, 7,500 pounds per week. Cost per pound, £5,463 16s. ($26,584.49) ÷(7,500 by 50)=3.54d. (7.08 cents) per pound.

The trade charge for spinning 2/44s. would be 4½d. (9 cents) per pound, which would include profits, administration, selling, and financing charges.

(2b) PLANT FOR PRODUCING 6,000 POUNDS PER WEEK 1/20s.

Capital expenditure:	£	s.	
2 revolving ball creels for 12 balls, at £11	22	0	= $107.06
2 double-can gill boxes, at £26	52	0	= 253.06
3 2-spindle gill boxes, at £26	78	0	= 379.59
1 6-spindle drawing box	25	0	= 121.66
1 8-spindle drawing box	30	0	= 146.00
1 12-spindle first finisher	36	0	= 175.19
2 12-spindle finishers, at £42	84	0	= 408.78
6 36-spindle rovers, at 27s per spindle	291	12	= 1,419.07
9 cap spinning frames 160 spindles, at 12s per spindle	864	0	= 4,204.66
Miscellaneous expenses	200	0	= 973.30
Total	1,682	12	= 8,188.37

Floor space required, 530 square yards; power required. 48½ indicated horsepower.

	Per week.			
Labor required:	£	s.	d.	
3 minders, at 12s. 6d	1	17	6	= $9.12
2 minders, at 12s	1	4	0	= 5.84
2 rovers, at 12s	1	4	0	= 5.84
9 spinners, at 10s	4	10	0	= 21.90
5 doffers, at 8s. 6d	2	2	6	= 10.34
1 jobber lad		11	0	= 2.67
1 taker off		10	0	= 2.43
1 setter		9	6	= 2.31
1 sweeper		7	0	= 1.70
1 overlooker	1	12	0	= 7.78
	14	7	6	= 69.95
Share of manager's wages	2	0	0	= 9.73
Total	16	7	6	= 79.68

Worsted spinning, 1/20s.

	Per year.		
Departmental costing:	£	s.	
Interest and depreciation (10 years), at 4½ per cent	214	16	= $1,045.50
Rent, 530 square yards, at 3s. 6d	92	15	= 451.37
Motive power, say 60 indicated horsepower, at £5	300	0	= 1,459.95
Repairs	20	0	= 97.33
Lighting, rates, taxes, and insurance	100	0	= 486.65
Materials	50	0	= 243.33
Miscellaneous expenses	10	0	= 48.66
Wages, 50 weeks, at £14 7s. 6d	718	15	= 3,497.50
Wages, 52 weeks, at £2	104	0	= 506.12
Total	1,610	6	= 7,836.44

Production, 7,500 pounds per week. Cost per pound, £1,610 6s. ($7,836.44) ÷(7,500 by 50)=1.03d. (2.06 cents) per pound.

The trade charge for spinning 1/20s. would be 2d. (4 cents) per pound, and would include profits, administration, selling, and financing costs.

Production of worsted spinning plant for 2/44s.

Speed of spindles, 7,000 revolutions per minute; turns twist per inch 1/44s, 13; production per minute per spindle, $\frac{7,000}{13 \text{ by } 36}$ yards.

Production per week of fifty-five and one-half hours, allowing 15 per cent for stoppages:

Yards per minute.	Minutes per week.	Spindles.	Per cent.	Yards per pound.
$\frac{7,000}{13 \text{ by } 36}$ by	60 by 55½ by	28 by 160 by	$\frac{85}{100}$ by	$\frac{1}{44 \text{ by } 560}$

Equals 7,697 pounds, say 7,500 pounds per week of fifty-five and one-half hours.

Production of worsted spinning plant for 1/20s.

Speed of spindles, 7,000 revolutions per minute; turns twist per inch, 9; production per minute per spindle, $\frac{7,000}{9 \text{ by } 36}$ yards.

Production per week of fifty-five and one-half hours, allowing 15 per cent for stoppages:

Yards per minute.	Minutes per week.	Spindles.	Per cent.	Yards per pound.
$\frac{7,000}{9 \text{ by } 36}$ by	60 by 55½ by	9 by 160 by	$\frac{85}{100}$ by	$\frac{1}{20 \text{ by } 560}$

Equals 7,862 pounds, say 7,500 pounds per week of fifty-five and one-half hours.

(3) WARPING AND BEAMING DEPARTMENT.

Capital expenditure:

5 warping and beaming machines, at £55	£275 =	$1,338.28
5 creels, at £20	100 =	486.65
Pulleys and belts	15 =	73.00
Miscellaneous apparatus	50 =	243.33
Total	440 =	2,141.26

	Per year.	
Departmental costing:	£ s.	
Interest and depreciation (13 years) on £450, at 4½ per cent.	46 9 =	$226.16
Repairs	5 0 =	24.33
Rent, 200 square yards, at 3s. 6d	35 0 =	170.33
Rates, taxes, gas, and insurance	32 0 =	155.73
Motive power, 3 indicated horsepower, at £5	15 0 =	73.00
Miscellaneous expenses	15 0 =	73.00
Wages, 5 warpers, at 18s. per week	225 0 =	1,094.96
Wages, 1 beamer, at 28s. per week	70 0 =	340.65
Total	443 9 =	2,158.16

Then £443 9s. 6d. ($2,158.16), divided by 8,000 cuts, gives cost per cut of 1s. 2d. (28.3 cents).

(4) WEAVING DEPARTMENT.

Capital expenditure:	£	s.	
100 84-inch box looms, 6 shafts, tappets, at £38	3,800	0	=$18,492.70
Straps, shuttles, temples, at 18s. 6d	92	10	=450.15
Pulleys and belts, at 16s	80	0	=389.32
Extra fittings	30	0	=146.00
Healds and slays	972	0	=4,730.24
Miscellaneous expenses	300	0	=1,459.94
Total	5,274	10	=25,668.35

	Per year.			
Departmental costing:	£	s.	d.	
Interest and sinking fund (10 years) on £5,300, at 4½ per cent	669	7	10	=$3,257.59
Repairs, including new healds and slays	180	0	0	=875.97
Rent, 1,500 square yards, at 3s. 6d	262	10	0	=1,277.43
Rates, taxes, gas, and insurance	220	0	0	=1,070.63
Motive power, 50 indicated horsepower, at £5	250	0	0	=1,216.63
Miscellaneous expenses	50	0	0	=243.33
Wages, 1 tuner at 40s.; 3 tuners at 37s. 6d. (52 weeks)	396	10	0	=1,929.50
Wages, 2 beamers, at 28s.; 12 twisters, at 17s. (50 weeks)	650	0	0	=3,163.24
Weaver's wages, 8,000 (cuts) by 18 (picks per ¼ inch) by 4¾d. (price paid per pick) per ¼ inch	2,850	0	0	=13,869.53
Total	5,528	7	10	=26,903.85

£5,528 7s. 10d. ($26,903.91) divided by 8,000 cuts=14s. ($3.30) per cut.

(5) PERCHING, MENDING, AND KNOTTING DEPARTMENT.

Capital expenditure:
Tables, forms, perches, scrays, numbering machines, etc., say ..... £200 = $973.30

	Per year.		
Departmental costing:	£	s.	
Interest and depreciation (20 years) on £200 at 4½ per cent	15	7	=$74.82
Rent, 300 square yards, at 3s. 6d	52	10	=255.49
Rates, taxes, gas, and insurance	40	0	=194.66
Wages, 50 weeks, at £21 4s	1,060	0	=5,158.49
Miscellaneous expenses	30	0	=146.00
Total	1,197	17	=5,829.46

£1,197 17s. 6d. ($5,829.45) divided by 8,000 = 3s. (72.9 cents) per piece.

(6) SCOURING AND FINISHING DEPARTMENT.

Capital expenditure:	£	s.	
3 washing and scouring machines, at £42	126	0	=$613.18
2 milling machines, at £40	80	0	=389.32
1 hydro-extractor	120	0	=583.98
1 tentering and drying machine	427	0	=2,078.00
1 brush dewing machine	45	0	=218.99
6 cutting machines, at £33	198	0	=963.57
1 extra set, 10 spiral cutters and blade	9	8	=45.74
2 brushing and steaming machines, at £88	176	0	=856.50

Capital expenditure—Continued.	£	s.	
1 double brushing machine	48	0 =	$233.59
4 hydraulic presses, 4 feet 6 inches lift, 12-inch ram, at £100	400	0 =	1,946.60
Press papers, plates, fencing, etc.	134	0 =	652.11
1 steam oven	29	0 =	141.13
1 hydraulic pump	92	0 =	447.72
1 single-screw baling press	16	0 =	77.86
1 [illegible]-inch grinding machine	55	0 =	267.67
Tables, scrays, pulleys, belting, etc.	60	0 =	291.99
Miscellaneous	150	0 =	729.98
	2,165	8 =	10,537.93
1 blowing machine, 1 rigging and cutting machine, say	300	0 =	1,459.95
Total	2,465	8 =	11,997.88

Fifty-five and one-half indicated horsepower required for power besides steam for blowing, brushing, tentering, driving hydro-pump, etc.

	Per year.
Labor:	£
1 head finisher, at £3 10s. per week	182= $885.70
1 head scourer, at £2 per week	102= 496.38
3 scourers (24s.) and millers, at £3 12s. per week	180= 875.97
1 tenterer, at £1 2s. per week	55= 267.66
4 finishers, at 25s., £5 per week	250=1,216.62
4 pressers, at 26s., £5 4s. per week	260=1,265.29
8 lads, at 16s., £6 8s. per week	320=1,557.28
Total	1,349=6,564.90

	Per year.		
Departmental costing:	£	s.	
Interest and depreciation (14 years) on £2,500, at 4½ per cent	244	10 =	$1,189.86
Repairs	35	0 =	170.32
Rent, 1,200 square yards, at 3s. 6d.	210	0 =	1,021.90
Rates (£90), taxes (£10), gas (£30), and insurance (£12½)	142	10 =	693.47
Motive power, say 65 indicated horsepower, at £5	325	0 =	1,581.61
Steam for tentering, brushing, blowing	250	0 =	1,216.63
Steam for driving hydro, tenter, pump	50	0 =	243.33
Water for scouring, 4,000,000 gallons, at 7d. (14c.) per 1,000	116	13 =	567.75
Soap and other materials	100	0 =	486.65
Wages	1,349	0 =	6,564.91
Miscellaneous	30	0 =	146.00
Total	2,852	13 =	13,882.43

£2,852 13s. 4d. ($13,882.49)÷8,000 pieces=7s. 1½d. ($1.735) per piece.

The country finisher with all expenses of collecting and delivering, office and financial charges, seeking-in work, etc., would charge from 9s. 6d. ($2.31) per piece for finishing.

(7) PIECE DYEING DEPARTMENT.

Capital expenditures:	£	
3 piece-dyeing machines, with engine and winch, at £43	129=	$627.78
3 chroming machines, with engine and winch, at £43	129=	627.78
3 coolers, at £18	54=	262.79
3 washing-off or scouring machines, at £40	126=	613.18
1 hydro-extractor	120=	583.98
2 indigo vats, with copper coil, steam taps, etc., at £33	66=	321.19
2 hawking machines, at £33	66=	321.19
2 piece squeezing machines, at £20	40=	194.66
Fixing and steam piping, pulleys, etc	200=	973.30
Miscellaneous	150=	729.97
Total	1,080=	5,255.82

Power required, 16 indicated horsepower. This plant would dye 180 pieces per week.

Labor:	£ s.	
1 dyer, at £4 per week	4 0=	$19.47
10 laborers, at 25s	12 10=	60.83
Total	16 10=	80.30

Floor space required 300 by 30 feet. Need steam for 7 small engines and for 11 machines (vats and washers).

	Per year.	
Departmental costing:		
Interest and depreciation (14 years) on £1,080, at 4½ per cent	£ s. 99 13=	$484.98
Repairs	30 0=	145.99
Rent, 1,250 square yards, at 30s. 6d	218 15=	1,064.54
Rates and taxes (£70), gas (£20), insurance (£3)	93 0=	452.58
Motive power, 16 indicated horsepower, at £5	80 0=	389.32
Steam for engines, 21 indicated horsepower, at £5	105 0=	510.98
Steam for vats and washers	700 0=	3,406.55
Dye wares	350 0=	1,703.27
Dye wares, indigo	500 0=	2,433.25
Wages, 50 weeks, at £12 10s	625 0=	3,041.56
Wages, 52 weeks, at £4	208 0=	1,012.23
Water	40 0=	194.66
Miscellaneous expenses	20 0=	97.33
Total	3,069 8=	14,937.27

Pieces dyed, 8,000. Cost per piece $\frac{£3,068}{8,000}$=7s. 8d. say 8s. ($1.944) per piece.

(8) WAREHOUSE AND SELLING DEPARTMENT.

Capital expenditure:

Tables, pattern-cutting machine, packing, press, etc., say £300=$1,459.95

	Per year.	
Departmental costing:		
Interest and depreciation (20 years) on £300 at 4½ per cent	£ s. 23 1=	$112.23
Rent, 200 square yards, at 3s. 6d	35 0=	170.33
Rates, taxes, gas, and insurance	60 0=	291.99
Wages, 2 warehousemen and lad, at 75s	187 10=	912.46
Packing materials	50 0=	243.33
Salaries and commission	1,500 0=	7,299.75
Miscellaneous, carriage, etc	200 0=	973.30
Total	2,055 11=	10,003.39

£2,056 11s. 3d. ($10,003.39) divided by 8,000 pieces=5s. 1¾d., say, 5s. 6d. ($1,335) per piece.

(9) FINANCE, OFFICE AND MISCELLANEOUS.

Capital expenditure:

Office fittings (£200), carts, horses, and miscellaneous (£1,000) ..... £1,200 = $5,839.80

	Per year.		
Departmental costing:			
Interest and depreciation (14 years) on £1,200, at 4½ per cent	£ 63	s. 7 =	$308.43
Rent, 100 square yards at 3s. 6d	17	10 =	85.16
Rates, taxes, gas, and insurance	50	0 =	243.33
Office materials, postage, etc	200	0 =	973.30
Cashier (£200) and clerks (£200), wages	400	0 =	1,946.60
Timekeeper's wages	50	0 =	243.33
Manager's wages	500	0 =	2,433.25
Cartage	250	0 =	1,216.63
Bad debts	150	0 =	729.98
Difference between discounts received and allowed, 2½ per cent on £9,800 = £2,450 less received £150	2,300	0 =	11,192.95
Interest on capital for stock and wages, £49,000, at 4½ per cent for three months	501	5 =	2,439.32
Total	4,482	2 =	21,812.28

£4,482 ($21,812.28) divided by 8,000 pieces = 11s. 3d., or $2.727, per piece.

COST AT HUDDERSFIELD.

SAMPLES OF WOOL GOODS—LAY OUT AND ESTIMATED COST.

Huddersfield is noted as the center of the fine worsted trade in the West Riding of Yorkshire, especially for men's high-class worsted wear. These goods are woven on wide looms, with one loom per weaver, and the weavers are mainly men, while the Bradford stuff mills use mainly women weavers, operating two narrow looms each.

Accompanying this report are eight samples of wool goods representing the fabrics made at Huddersfield, England. The lay out and estimate of cost are given for each fabric, the estimate being made in each case for 1,056 yards of cloth. Samples 1 to 6 are worsted goods and the cost estimates are based on the manufacture in a mill buying the worsted yarn, as is the custom in this district. Nos. 7 and 8 are carded woolen goods, and as such fabrics are manufactured in one mill from the wool or shoddy, the estimates of cost cover all operations from the loose raw material to the finished goods. The yarn counts for worsted, cotton, and spun silk are the same as those used in the United States. (The Huddersfield count for woolen yarn has been reduced to the run basis.)

The weights of the material as given include an allowance for waste in the various processes. The cost of manufacturing the cloth is apportioned to the various departments of the mill as follows:

Office expenses include, besides the regular office expense, differences in discount given and received and in terms of payment given and received.

The warehouse item includes warehouse expenses, packing material, traveling and selling expense, commission for selling, and all other expenses in the shipping and marketing of cloth.

Patterns include cost of getting out styles, travelers' lengths, also salaries of designers.

Weaving includes warping, beaming, and putting up, as well as weavers' wages and all other expenses of this department.

Mending includes knotting and burling. Finishing includes all the processes necessary for preparing the cloth for the warehouse. It is connected with dyeing, as in the case of the dyed piece it is simpler to combine the charges for dyeing and finishing.

DIFFERENCES ACCOUNTED FOR.

The differences in discount given and received, included under office expenses, are considerable, because the discount is allowed on the total cost of the cloth, which includes many items, such as wages and salary, rent, etc., on which no discount is received.

Office expenses also include the differences in terms of payment. Many goods bought for manufacturing are paid for on much shorter terms than the goods sold; that is, wool must be paid for in seven days; in addition the material is lying idle for the period of time required for manufacture, this varying on different classes of goods.

The terms of payment for cloth sold are very easy in the Huddersfield trade, and probably six months would barely cover the time from paying for the raw material to receiving the payment for the cloth sold.

With regard to wages, nearly the same length of time would elapse between paying and receiving payment for the cloth. Hence a large amount of floating capital is necessary to finance a Huddersfield mill. The amount of this item is included in the office expenses and financial charges column and varies according to the cost of raw material, rates of wages, terms, and other expenses.

The samples, lay out, and estimates of cost follow:

FIG. 5.—SAMPLE NO. 1.—FANCY WORSTED SUITING.

[1,056 yards, high grade; weight per square yard, 13.6 ounces; thread per inch in warp 42, filling 40; grade, botany No. 70, at 74 cents; yarn 1,530 pounds, 2/16s.]

	Yarn.	Interest and depreciation.	Repairs.	Rent.	Gas, etc.	Power.	Supplies.	Wages.	Salaries.	Total.
Material	$1,132.20									$1,132.20
Office expense				$0.34	$0.16		$0.12		$20.18	20.80
Discounts, terms, etc		$30.60								30.60
Warehouse				2.96	1.64		1.48	$2.96	20.56	29.60
Patterns				.24	.24		1.16	26.88	5.08	33.60
Weaving		11.70	$3.12	4.56	4.70	$3.92	1.30	82.64	18.94	130.88
Mending				1.20	1.20			21.60		24.00
Finishing and dyeing		10.08	1.78	5.98	4.98	10.36	12.60	48.60	2.10	96.48
Total	1,132.20	52.38	4.90	15.28	12.92	14.28	16.66	182.68	66.86	1,498.16

Cost per yard, 58 inches, $1.419.

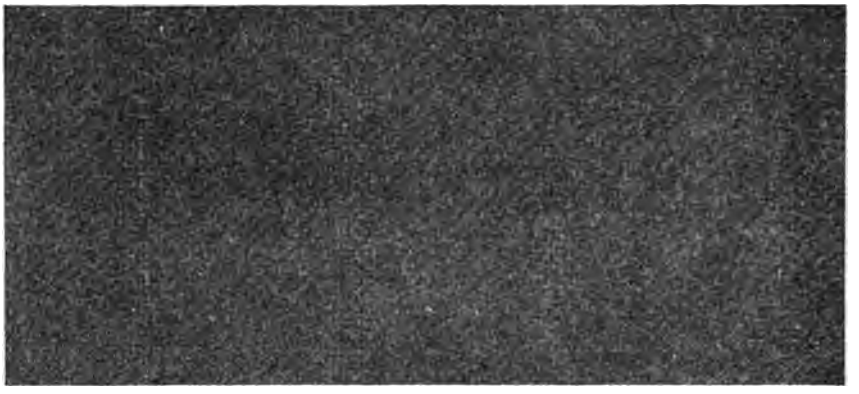

FIG. 6.—SAMPLE NO. 2.—FANCY WORSTED SUITING.

[1,056 yards, medium quality; weight per square yard, 11.8 ounces; threads per inch in warp 45, filling 48; grade, dark gray botany No. 64 at 66 cents; No. 64 at 74 cents; yarn, 1,370 pounds, 2/20s.]

	Yarn.	Interest and depreciation.	Repairs.	Rent.	Gas, etc.	Power.	Supplies.	Wages.	Salaries.	Total.
Material	$908.20									$908.20
Office expense			$0.36	$0.18	$0.18		$0.12	$20.82	$0.12	21.60
Discounts, terms, etc		$27.40								27.40
Warehouse				3.12	1.72		1.56	3.12	21.68	31.20
Patterns				.16	.06		.72	16.58	3.28	20.80
Weaving		12.36	3.30	4.80	4.94	$4.12	1.38	86.40	19.90	137.20
Mending				1.20	1.20			21.60		24.00
Finishing and dyeing		6.30	1.08	3.72	3.12	6.48	8.10	30.48	.72	60.00
Total	908.20	46.06	4.38	13.36	11.22	10.60	11.88	179.00	45.70	1,230.40

Cost per yard, 58 inches, $1.165.

FIG. 7.—SAMPLE NO. 3.—FANCY WORSTED AND WOOLEN SUITING.

[1,056 yards; weight per square yard, 11.9 ounces; threads per inch in warp 56, filling 54; grade, botany No. 1, 60s, at 67 cents; No. 2, 60s, at 67 cents; woolen weft, at 30 cents; yarn, 570 pounds, No. 1, 2/28s; 330 pounds, No. 2/24s; 534 pounds, woolen, 2 5/8 runs.]

	Yarn.	Interest and depreciation.	Repairs.	Rent.	Gas, etc.	Power.	Supplies.	Wages.	Salaries.	Total.
Material	$764.28									$764.28
Office expense		$19.08								19.08
Discounts, terms, etc				$0.36	$0.18		$0.12	$20 82	$0.12	21.60
Warehouse				3.12	1.72		1.56	3.12	21.68	31.20
Patterns				.16	.06		.72	16.58	3.28	20.80
Weavfng		12.36	$3.30	4.80	4.94	$4.12	1.38	86.40	19.90	137.20
Mending				1.20	1.20			21.60		24.00
Finishing and dyeing		6.30	1.08	3.72	3.12	6.48	8.10	30.48	.72	60.00
Total	764.28	37.74	4.38	13.36	11.22	10.60	11.88	179.00	45.70	1,078.16

Cost per yard, 58 inches, $1.021.

Sample No. 4—Piece Dyed Indigo Suiting.

[1,056 yards; weight per square yard, 14.0 ounces; threads per inch in warp 44, filling 48; grade, botany No. 80, at 66 cents; yarn, 1,500 pounds, 2/20s.]

	Yarn.	Interest and depreciation.	Repairs.	Rent.	Gas, etc.	Power.	Supplies.	Wages.	Salaries.	Total.
Material	$990.00									$990.00
Office expense				$0.36	$0.18		$0.12	$20.82	$0.12	21.60
Discounts, terms, etc		$30.00								30.00
Warehouse				3.12	1.72		1.56	3.12	21.68	31.20
Patterns										
Weaving		9.84	$2.64	3.84	3.90	$3.26	1.10	69.12	15.98	109.68
Mending				1.20	1.20			21.60		24.00
Finishing and dyeing		15.12	2.56	8.90	7.50	15.60	141.84	72.48		264.00
Total	990.00	54.96	5.20	17.42	14.50	18.86	144.62	187.14	37.78	1,470.48

Cost per yard, 58 inches, $1.392.

Sample No. 5.—Wool Dyed Indigo Suiting.

[1,056 yards; weight per square yard, 9.8 ounces; threads per inch in warp 48, filling 48; grade, botany worsted No. 70, at 80 cents per pound; yarn, 1,180 pounds, 2/24s.]

	Yarn.	Interest and depreciation.	Repairs.	Rent.	Gas, etc.	Power.	Supplies.	Wages.	Salaries.	Total.
Material	$944.00									$944.00
Office expense				$0.36	$0.18		$0.12	$20.82	$0.12	21.60
Discounts, terms, etc		$31.20								31.20
Warehouse				3.12	1.72		1.56	3.12	21.68	31.20
Patterns				.16	.06		.72	16.58	3.28	20.80
Weaving		10.44	$2.78	4.08	4.20	$3.48	1.16	73.20	16.66	116.00
Mending				1.20	1.20			21.60		24.00
Finishing and dyeing		10.08	1.76	5.96	5.00	10.36	12.96	48.60	1.28	96.00
Total	944.00	51.72	4.54	14.88	12.36	13.84	16.52	183.92	43.02	1,284.80

Cost per yard, 58 inches, $1.216.

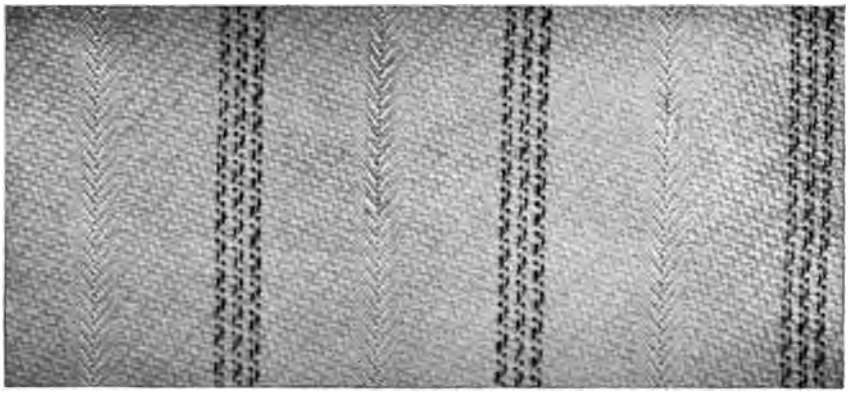

FIG. 8.—SAMPLE NO. 6.—WOOL DYED INDIGO SUITING.

[1,056 yards; weight per square yard, 9.8 ounces; threads per inch in warp, 48, filling 48; grade, botany worsted (white) No. 70, at 68 cents, (black) No. 70, at 68 cents; white spun silk, at $3; yarn, 500 pounds, 2/28s; 25 pounds, 10/4s silk.]

	Yarn.	Interest and depreciation.	Repairs.	Rent.	Gas, etc.	Power.	Supplies.	Wages.	Salaries.	Total.
Material	$415.00									$415.00
Office expense				$0.36	$0.18		$0.12	$20.82	$0.12	21.60
Discounts, terms, etc		$33.60								33.60
Warehouse				3.12	1.72		1.56	3.12	69.68	79.20
Patterns				.44	.44		2.00	46.08	8.64	57.60
Weaving		15.96	$4.26	6.24	6.36	$5.34	1.78	109.44	28.22	177.60
Mending				1.20	1.20			21.60		24.00
Finishing and dyeing		10.08	1.76	5.96	5.00	10.36	12.96	48.60	1.28	96.00
Total	415.00	59.64	6.02	17.32	14.90	15.70	18.42	249.66	107.94	904.60

Cost per yard, 58 inches, $0.856.

FIG. 9.—SAMPLE NO. 7.—FANCY TWEED, LOW QUALITY.

[1,056 yards; weight per square yard, 11.9 ounces; threads per inch in warp 36, filling 32; grade, woolen blend at 20 cents, cotton yarn at 22 cents, worsted yarn and twist at 56 cents; material 1,310 pounds, woolen blend, 250 pounds, 1/20s., 60 pounds, 2/14s.]

	Yarn.	Interest and depreciation.	Repairs.	Rent.	Gas, etc.	Power.	Supplies.	Wages.	Salaries.	Total.
Material	$350.62									$350.62
Office expense										
Discounts, terms, etc		$3.72		$0.18	$0.10		$0.06	$11.60	$0.06	15.72
Warehouse				1.52	.76	$0.08	.76	10.56	1.52	15.20
Patterns				.08	.08		.42	9.60	1.82	12.00
Weaving		8.20	$2.20	3.20	3.52	2.74	.10	57.60	13.64	91.20
Mending				.60	.60			10.80		12.00
Finishing and dyeing		5.04	.86	2.98	2.50	5.18	6.48	24.36	.60	48.00
Carding, spinning, and twisting		19.80	1.48	7.44	5.72	9.70	4.64	27.68	7.54	84.00
Total	350.62	36.76	4.54	16.00	13.28	17.70	12.46	152.20	25.18	628.74

Cost per yard, 58-inch, 59.5 cents.

FIG. 10.—SAMPLE NO. 8.—FANCY FINE WOOLEN OVERCOATING.

[1,056 yards; weight per square yard, 11.9 ounces; threads per inch in warp 60, filling 60; grade, fine Saxony woolen blend at 56 cents; wool, 1,420 pounds.]

	Yarn.	Interest and depreciation.	Repairs.	Rent.	Gas, etc.	Power.	Supplies.	Wages.	Salaries.	Total.
Material	$795.20									$795.20
Office expense		$3.60		$0.36	$0.18		$0.12	$20.82	$0.12	55.20
Discounts, terms, etc										
Warehouse				3.12	1.72		1.56	3.12	21.68	31.20
Patterns				.44	.24		2.00	46.08	8.64	57.40
Weaving		17.28	$4.60	6.72	6.90	$5.76	1.92	120.48	28.34	192.00
Mending				1.20				21.60		22.80
Finishing and dyeing		12.60	2.16	7.44	6.24	12.96	16.20	60.96	1.44	120.00
Carding and spinning		34.80	2.40	13.10	10.08	17.04	8.16	48.60	11.86	146.04
Total	795.20	98.28	9.16	32.38	25.36	35.76	29.96	321.66	72.08	1,419.84

Cost per yard, 58-inch, $1.344.

ENGLISH AND AMERICAN COSTS.

THE MANUFACTURE OF BRADFORD GOODS CONTRASTED WITH AMERICAN PRODUCT SHOWS MARKED DIFFERENCES.

In the course of investigations into the English woolen industry there was obtained 18 specific samples of goods with exact cost of manufacture of each. These samples ranged from low tweeds (shoddy) to men's high-grade worsteds. An American mill was found that makes goods almost precisely similar to that of four of the samples of Bradford stuffs, and the home cost of manufacture has been obtained. On these samples the cost of manufacture per yard follows:

Samples.	England.	United States.	Difference.	Duty.
			Per cent.	*Per cent.*
A. Cotton and worsted cashmere	$0.1560	$0.2600	67	104.8
B. Cotton and worsted cashmere	.1785	.2987	67	100.5
C. All-wool sateen	.3112	.7070	127	115.7
D. All-wool serge	.1700	.4365	156	146.8

The description and detailed cost of above samples is as follows:

SAMPLE A.—CASHMERE MADE OF COTTON AND LOW BOTANY WOOL.

This cloth is 42 inches wide and has 76 warp ends and 72 weft ends per inch. A yard weighs 3.22 ounces (.2 lb.), of which 1.28 ounces, or 39.8 per cent, is No. 50s cotton warp and 1.94 ounces, or 60.2 per cent, is No. 66s worsted weft. A yard length=1.166 square yards. A square yard=$\frac{15.6}{1.166}$=14.7 cents. A pound costs $\frac{15.6}{.2}$, or 78 cents.

The Yorkshire (Bradford) mill costs of this cloth were given as follows:

	Yarn cost.	Weaving wage.	Expenses.	Dyeing.	Total.
Cost of 65 yards	$6.075	$0.829	$1.658	$1.578	$10.14
Cost of 1 yard	.093	.013	.026	.024	.156
Per cent of total	59.6	8.3	16.7	15.4	100

The manufacturer's selling price at the British mill was given at $10.629 per 65-yard cut, or $0.164 a yard.

The manufacturing costs of this same cloth were also obtained at a large Massachusetts mill. In this case the width was the same, but the cuts were 48 yards; each yard weighed 3.36 ounces, of which 1.46 ounces, or 43.5 per cent, was warp and 1.90 ounces, or 56.5 per cent, was weft. The manufacturing costs were given as follows:

	Yarn cost.	Weaving wage.	All other costs.	Total.
Cost of 48 yards	$7.47	$3.07	$1.94	$12.48
Cost of 1 yard	.154	.064	.042	.260
Per cent of total	59.2	24.6	16.2	100

This shows the American cost of manufacture per yard to be 66⅔ per cent higher than the English.

These goods fall under paragraph 368 of the 1897 tariff:

	Cents a yard.
Duty at 7 cents a square yard	8.162
Duty at 55 per cent ad valorem	9.02
Total duty	17.182

or 104.8 per cent ad valorem.

SAMPLE B.—CASHMERE MADE OF COTTON AND BOTANY WORSTED.

This cloth is 44 inches wide and has 71 warp ends and 93 weft ends per inch. A yard weighs 3.86 ounces (.241 pound), of which 1.60 ounces, or 41.5 per cent, is No. 50s cotton warp and 2.26 ounces, or 58.5 per cent, is No. 66s worsted weft. A yard length=1.222 square yards. A square yard=$\frac{17.85}{1.222}$=14.6 cents. A pound costs $\frac{17.85}{.241}$, or 74.1 cents.

The English costs were as follows:

	Yarn cost.	Weaving wage.	Expenses.	Dyeing.	Total.
Cost of 67 yards	$7.713	$1.012	$2.024	$1.215	$11.964
Cost of 1 yard	.1151	.0151	.0302	.0181	.1785
Per cent of total	64.5	8.5	16.9	10.1	100

The manufacturers' selling price at mill was $12.59 per 67-yard cut, or $0.188 per yard.

The American costs were as follows:

	Yarn cost.	Weaving wage.	All other costs.	Total.
Cost of 48 yards	$9.15	$3.08	$2.11	$14.34
Cost of 1 yard	.191	.0642	.0435	.2987
Per cent of total	63.9	21.4	14.7	100

This shows the American cost of manufacture per yard to be 66⅔ per cent higher than the English.

These goods fall under paragraph 368 of the 1897 tariff:

	Cents a yard.
Duty at 7 cents a square yard	8.554
Duty at 55 per cent ad valorem	10.34
Total duty	18.894

or 100.5 per cent ad valorem.

SAMPLE C.—ALL-WOOL SATEEN OF BOTANY WOOL.

This cloth is 42 inches wide and has 110 warp ends and 53 weft ends per inch. A yard weighs 7.07 ounces (.442 pound), of which 4.70 ounces, or 66.5 per cent, is No. 62/2 worsted warp, and 2.37 ounces, or 33.5 per cent, is No. 30/1 worsted weft. A yard length=1.166 square inches. A square yard=$\frac{31.12}{1.166}$=26.7 cents. A pound costs $\frac{31.12}{.442}$, or 70.4 cents.

The English costs were as follows:

	Yarn cost.	Weaving wage.	Expenses.	Dyeing.	Total.
Cost of 81 yards	$18.102	$1.152	$2.307	$3.645	$25.209
Cost of 1 yard	.2235	.0142	.0285	.0450	.3112
Per cent of total	71.8	4.6	9.2	14.4	100

The manufacturers' selling cost at mill was $25.595 per 81-yard cut, or $0.316 per yard.

The American costs were as follows:

	Yarn cost.	Weaving wage.	All other costs.	Total.
Cost of 31 yards	$17.57	$1.807	$2.54	$21.917
Cost of 1 yard	.567	.0583	.0817	.7070
Per cent of total	80.2	8.2	11.6	100

This shows the American cost of manufacture per yard to be 127 per cent higher than the English.

Duty under paragraph 366 of the 1897 tariff:

	Cents a yard.
Duty at 44 cents a pound	19.448
Duty at 55 per cent ad valorem	17.116
Total duty	36.564

or 115.7 per cent ad valorem.

SAMPLE D.—ALL WOOL SERGE MADE OF CROSSBRED WOOL.

This cloth is 42 inches wide and has 53 warp ends and 42 weft ends per inch. A yard weighs 6.16 ounces (.285 pound), of which 3.42 ounces, or 55.6 per cent, is No. 42/2 worsted warp and 2.74 ounces, or 44.4 per cent, is No. 20/1 worsted weft. A yard length=1.166 square yards. A square yard=$\frac{17}{1.166}$=14.6 cents. A pound costs $\frac{17}{.385}$, or 44.1 cents.

The English costs were as follows:

	Yarn cost.	Weaving.	Wage expenses.	Dyeing.	Total.
Cost of 91 yards	$10.79	$0.769	$1.538	$2.367	$15.464
Cost of 1 yard	.119	.008	.017	.026	.17
Per cent of total	70.0	4.7	10.0	15.3	100

The manufacturers' selling cost at mill was $15.90 per 91-yard cut, or $0.175 a yard.

In the foregoing examples the English manufacturer itemized his total costs into cost of yarn, weaving wage, expense, and dyeing, while the American manufacturer itemized his costs into cost of yarn, weaving wage, and all other costs. Both mills were weave mills and bought their yarn. One-third of the cost of dyeing is labor cost and, as the "weaving wage" is intended to include all costs for labor from the yarn to the finished cloth, to get an exact comparison one-third of the dyeing charge should be added to the English weaving wage given to obtain the weaving wage for comparison with the American weaving wage. For the first sample given, Sample A, cotton and worsted cashmere, the comparison can therefore be made as follows:

SAMPLE A.—COTTON AND WORSTED CASHMERE.

	Yarn cost.	Weaving wage.	All other costs.	Total cost cts. a lb.
English	9.3	2.1	4.2	15.6
American	15.4	6.4	4.2	26.0

SAMPLE C.—ALL-WOOL SATEEN.

English	22.35	2.92	5.85	31.12
American	56.70	5.83	8.17	70.70

The details given for this sample apply to all of the wool samples.

CONSULAR REPORTS.

BRADFORD CONDITIONING HOUSE.

VALUABLE WORK PERFORMED—THE SCHEDULE OF CHARGES.

Deputy Consul R. B. Nicholls furnishes the following information regarding the work of the Bradford Conditioning House:

The number of conditioning houses in operation are not numerous, and, excepting the silk one at New York, are confined to the continent of Europe. The principal ones under municipal or chamber of commerce control being, for wools, at Roubaix, Tourcoing, Rheims, Fourmies, La Cateau, and Amiens, in France; Leipzig and Elberfeld, in Germany; and Verviers and Mazermet, in Belgium; for silks, at Lyons, Milan, Elberfeld, Crefeld, Bale, Zurich, and Turin.

It is recognized among traders in wool and its manufactures that serious differences often arise between the weights and condition of goods invoiced and actually received, owing to the variable humidity of the atmosphere. Particularly does this apply when the consignment is intended for foreign countries, and more especially hot countries, or where the merchandise passes in transit through such regions. It was in order to test merchandise submitted for that purpose, by fixed standards, that the Bradford Conditioning House was originally opened in 1891. It is the only municipal house of this nature in Great Britain, being under the control of the city council and recognized by the Board of Trade, which makes use of its services as occasion requires.

The present building, which is one of the largest of its kind in the world and has a floorage of 3½ acres, was opened in 1902, at a cost of £34,000 ($165,461) exclusive of land, and is erected around three sides of a large covered court, which is used for loading and unloading. It is five stories in height and the greater portion is devoted to wool warehousing, over 15,000 square yards being allotted for that purpose. The top floor of one-half of the building is fitted up as a testing department. The whole is supplied with electric light, fireproof doors and floors, and is constructed in sections, so that any outbreak of fire could be isolated and easily dealt with.

RESULTS ACCOMPLISHED BY THE HOUSE.

Among the many features which have been added of late years are commercial scour tests for oil and insolubles in tops, noils, wastes, yarns, and cloths; commercial scour tests for yield in raw wools; lengths, counts, twist, and strength of yarns; tensile strength of cloths; analysis of cloths, yarns, and fibers; chemical analysis of damaged wools, yarns, and cloth; tops in oil; dry combed tops;

worsted yarns; woolen yarns and waste; cloths. In order to secure results as perfect as possible, all tests and calculations are made in duplicate, by separate individuals, with the most approved and up-to-date scientific apparatus.

Years of elaborate experiments have proved that absolutely dry goods when exposed to the atmosphere regain a varying amount of moisture, and as a result certain percentages of moisture have been fixed which are recognized as "official standards." In the case of wools it amounts to 16 per cent; tops combed with oil, 19 per cent; tops combed without oil, 18¼ per cent; worsted and woolen cloths, 16 per cent; ordinary noils, 14 per cent; clean noils, 16 per cent; worsted yarns, 18¼ per cent; cotton yarns, 8½ per cent; silk yarns, 11 per cent. With each test a certificate (specimen of which is attached to this report) is issued under the corporate seal. The

FIG. 11.—City of Bradford Conditioning House.

results covered by these certificates are accepted by both seller and buyer, and on the basis of these certificates transactions are settled.

The conditioning ovens, 46 in number, in which tests for moisture are obtained, are of cylindrical shape, having an inner and outer case, a space of 1½ inches being allowed between the two, to permit the heated air circulating freely. They are 40 inches high with a diameter of 30 inches, and are heated with hot air at about 130° F. forced through pipes from a central chamber. This air is superheated to from 220° to 230° by a Bunsen's gas burner, having 80 circular jets consuming 75 per cent of air fixed beneath each inner oven. A pipe at the opposite side of the outer oven conveys the air, moisture, and gas fumes away, none of the latter being permitted to come in contact with the article under treatment.

SELECTING SAMPLES FOR TESTS.

In testing wools or tops the samples are taken so as to secure fair representation, and when submitted in bulk they are extracted from each individual bale or sheet. In the case of wool, handfuls are taken from 9 different parts of the sheet, and in tops 3 balls are selected from each bag, in every bag from different positions, and samples taken from the outside, midway, and center. These are placed on a very finely adjusted pair of scales firmly fixed to the drying oven, one end of the beam being exactly over the center of the latter, to which is suspended a cage. This cage is perforated at the bottom and contains the sample, through which the hot air is forced until all the moisture is extracted and it ceases to lose weight. The quantity tested is usually 2 pounds, being 1 pound each test. The amount of weight lost is ascertained to one-tenth of a dram by weights, which are placed in a cup fixed to the scale above the cage. The weight given at each examination is recorded on a printed slip by the attendant, and when the last two records show no variation, indicating that absolute dryness has been secured, the result is checked by a foreman. Usually four or five examinations are made before the result is obtained. In the event of the tests varying more than 1 per cent, further samples are taken and tested, in order to secure reliable average results.

Yarns are tested for moisture in a similar manner, save that the weight is not confined to an exact pound, the sample hank being treated whole, about 4 pounds in every 1,200 pounds; when on bobbins or tubes, 20 to 40 of these. In the case of warps in balls or on beams a number of entire ends are taken. In piece goods an exact half yard is tested and the result proportioned to the length of the piece. To ascertain the twist in folded yarns, the average is taken from ten tests of 10 inches each. The strength of cloth is tested by machines on the dead-weight principle, power driven, with clock-indicating registers. An analysis of cloth can be obtained for the weave, ends and picks, counts, twist, quality of warp and weft, percentages of component parts, grease, free dye ware, size and filling, fastness, and base of dye.

CHARGES FOR CONDUCTING TESTS.

The following is the scale of charges:

	Per test. s.	d.	
For conditioning from bulk lots:			
Wool, noils, etc., in bales and sheets.....each..	1	6—	$0.36
Tops.....each..	1	0—	.24
Hank yarn.....each..	1	0—	.24
Spool, tube, or bobbin yarn.each..	2	0—	.48
Skeps and tares, each at normal condition.....each..	1	6—	.36
Piece goods.....each..	4	0—	.97
For conditioning from sample lots:			
Wool, noils, tops, or hank yarn, each.....	1	0—	.24
Spool, tube, or bobbin yarn.each..	2	0—	.48
Cloths.....each..	1	0—	.24
For yarn:			
Counts as received, twist, strength.....each..	1	6—	.36
Counts and condition, hank yarn, each.....	2	6—	.60
Counts and condition, tube or bobbin yarn.....each..	3	6—	.85
Length of hanks.....each..	3	0—	.73
For scouring, cleansing, drying, and conditioning:			
Commercial scouring.....each..	3	0—	.73
Insolubles test.....from..	1	0—	.24
Commercial scouring tube or bobbin yarn.....each..	4	0—	.97

	Per test. s.	d.	
Analyses of cloths, yarns, etc.:			
Dissecting of cloths and yarns....	Special rate.		
Measurement of pieces.....	Special rate.		
Chemical analyses:			
Proportion of cotton and wool or silk in mixed goods.....each..	4	0—	$0.97
Analysis of textile soaps..from..	10	6—	2.55
Analysis of wool oils.....from..	10	6—	2.55
Analysis of wool oils.....to....	21	0—	5.10
Net oil in tops, yarns, and cloths, each.....	4	0—	.97
Government tests:			
Strength and elasticity of cloths, warp and weft ways.....each..	2	0—	.48
Warps:			
Measurement, condition, counts, and correct weight.....each..	4	0—	.97
Wool results:			
Absolute scouring of samples, from.....	3	0—	.73
Samples pertaining to contracts: registered and filed with a reference number.....each..	2	6—	.60
Duplicate certificates.....each..		6—	.12

REVENUE AND EXPENDITURE.

The following table will give some idea of the extent to which the Bradford Conditioning House has developed since its opening, August 8, 1891. The figures are for the years ending March 31.

Income.					Salaries and wages paid.				
Year.	£	*s.*	*d.*		*Year.*	£	*s.*	*d.*	
1892.....	203	16	7—	$991.93	1892.....	271	13	1—	$1,322.00
1893.....	652	0	8—	3,173.11	1893.....	434	17	4—	2,116.26
1907.....	11,892	9	9—	57,874.78	1907:				
1908.....	16,231	19	8—	78,992.93	Officials.....	611	13	4—	2,976.67
					Workmen.....	4,714	3	6—	22,941.53
					Total	5,325	16	10—	25,918.20
					1908:				
					Officials.....	532	1	8—	2,589.36
					Workmen.....	5,512	2	1—	26,824.65
					Total	6,044	3	9—	29,413.03

The staff consists of 106 persons, which includes 26 officials and 80 workmen.

During the year ended March 31, 1907, 72,328,087 pounds were tested, while the amount during the year ended March 31, 1908, was 74,214,573 pounds. This represents tests of wool, tops, noils, waste, and yarns. The 1907 figures cover 163,797 tests, of which 140,747, or about 90 per cent, were tops.

The utmost secrecy is maintained regarding transactions, and any attempted collusion between customers and employees is reduced to practically an impossibility. Samples for treatment are passed from one department to another under a number. All goods received are insured against fire and water by a floating policy which at present stands at £80,000 ($389,320). The management is in the hands of a

practical and thoroughly capable man, whose aim is to place the Bradford Conditioning House at the head of all such institutions.

The following is a blank form certificate:

SPECIMEN CERTIFICATE.

Entry No..... Prog. No.....

CITY OF BRADFORD.

CONDITIONING HOUSE.

The Bradford Corporation (Various Powers) Act, 1887.

Bradford, ..., *190*...

Delivered by.....

.....Gross weight being.....lbs.

.....Tare being.....lbs.

Net weight being.....lbs.

Lbs. *ozs.* *drs.*

.....Lots extracted from the above, weighing net.....

resulting after testing absolutely dry.....

or loss per lb.....

or total dry weight.....lbs. or.....%

Regain.....%.....lbs. or.....%

Invoice weight, as per Tests, ...lbs. or.....%

Loss or Gain.....lbs. or.....%

Original weight.....lbs. or.....%

CHARGES.

	£	s.	d.
Tests.....			
.....			
Weighing....			
Postage.....			
Duplicates..			
Repacking..			
.....			

I hereby certify that the above is a correct return of the tests made by me of the samples referred to; in testimony whereof the corporate common seal of the said city has been affixed hereto this....day of .....190..

(Signed) .....

Manager.

Verified by

.....

[CORPORATE SEAL.]

CONDITIONS AT HUDDERSFIELD.

CONSIDERABLE DEPRESSION AND COMPETITION IN THE INDUSTRY.

Consul F. I. Bright, of Huddersfield, furnishes the following review of the woolen and associated industries in that British district for the first half of 1908 and a description of the Cloth Hall there:

Although trade conditions were greatly depressed during the first six months of the current year, the industries of this district, generally, enjoyed a fair degree of activity, considering the general decline in trade throughout the country. Makers of fancy woolens and worsteds have been employed with orders from the Continent, especially France, Germany, and Belgium.

Manufacturers of medium grade cloths and cheap tweeds, who during recent years have enjoyed exceptional prosperity, were not so fortunate. Their trade has greatly declined, employment has been restricted, and some machinery idle. This branch of the trade depends largely upon the demand from wholesale clothing houses.

The cheap and low woolen trade has experienced more difficulty than any other branch. This trade suffered not only on account of the greatly restricted demand, but also from foreign competition. There have been a number of failures, and mills which have been working overtime for many years have discharged large numbers of employees. Japan has been one of the best customers.

TRADE WITH THE UNITED STATES.

The value of declared exports from this district to the United States during the six months ended June 30 was $406,533, a decrease of $347,249, or about 45 per cent, as compared with the corresponding period in 1907, when the exports amounted to $753,783. This decrease was due to a general falling off in trade, but the greatest losses were in wool, $102,234; card clothing and other machinery, $89,654; woolens, $45,308, and worsteds, $37,217.

Most of the chemicals consisting of coal-tar products used in the United States by color chemists are supplied from this district. The trade in these items has not greatly diminished. Manufacturers of chemicals claim to be greatly favored by the climate here, which is free from great extremes of heat and cold.

Trade with the United States has shown a marked improvement during the last two or three months. The exports during July were $8,093 greater in value than for July, 1907, but the number of invoices fell from 112 to 78.

The following statement shows the gross value of declared exports from the consular district of Huddersfield to the United States during the six months ending June 30, 1907 and 1908:

Articles.	1907.	1908.	Articles.	1907.	1908.
Woolens	$93,585	$48,277	Sewing cottons	$34,762	$26,707
Worsteds	144,924	107,707	Miscellaneous	28,715	16,044
Other fabrics	50,689	18,189			
Wool	132,003	29,769	Total	753,783	406,533
Chemicals and dyes	133,274	113,663			
Card, clothing, and other machinery	135,831	46,177			

The Huddersfield Cloth Hall, a large building erected in 1766 for the accommodation of cloth manufacturers, is a relic of the old days when the line between the manufacturing and merchanting of cloth was very closely drawn. There are three other cloth halls in the great textile district of the West Riding of Yorkshire, located at Halifax, Bradford, and Leeds.

CHANGE IN BUSINESS METHODS.

Formerly manufacturing was very largely in the hands of so-called "clothiers" or small manufacturers, who devoted themselves exclusively to manufacturing and had little or no knowledge of markets and the business of merchanting. The clothier brought the finished cloth to the cloth hall, where it was exhibited and sold to specialized cloth merchants, woolen and worsted merchants, who handled all goods, whether for the home or foreign markets.

With the development of the factory system the specialized cloth merchant has been almost entirely driven out of the home market. I know of none in this district. Manufacturers took up the business of merchanting, and merchants that of manufacturing, and the gradual growth of the practice of direct dealing between manufacturers and customers finally brought to an end the middleman and the business for which the Cloth Hall had been constructed. The development of the wholesale clothing business, which afforded a convenient and ready market for large quantities of cloth, and which is now one of the most important industries in this district, had a great deal to do with bringing about this change. It is now quite common in this district for mill owners and manufacturers to do a large part of their own commercial traveling in preference to intrusting it to a regular traveling salesman.

OPPORTUNITY FOR AMERICAN TRADE JOURNALS.

However, Cloth Hall may still be regarded as the center of business for the woolen and worsted trades of this district, as well as of other branches of commerce. On market days, Tuesdays and Fridays of each week, men gather here from all parts of the district to transact business and discuss commercial subjects. The chamber of commerce has its council room here, where it holds its regular meetings. A spacious reading room, where the leading commercial publications and directories, technical and trade journals are kept on file, has been provided and is open daily for the use of business men.

Foreign and colonial journals are received, and it is the custom to keep current numbers of all these publications on file. When the succeeding issues arrive the old ones are taken to the Huddersfield public library, where an opportunity is given to the general public to read them. The secretary of the chamber of commerce and other officers assure me that any American trade and technical journals which may be sent will be received and filed in the same manner as domestic and colonial publications, provided they come without expense to the chamber of commerce. All such publications should be addressed Chamber of Commerce, Huddersfield, England, Cloth Hall or Exchange Building.

MANUFACTURE OF SHODDY IN THE UNITED KINGDOM.

EXPANSION OF SHODDY TRADE.

A HIGHLY DEVELOPED LINE OF MANUFACTURE—INTRICATE SYSTEM OF BUYING, HANDLING, AND SELLING.

The amount of manufactured wool that is remanufactured in Great Britain every year is considerably more than the total wool clip of the country and makes up one-fourth of the total animal fibers employed. The Bradford Chamber of Commerce estimates

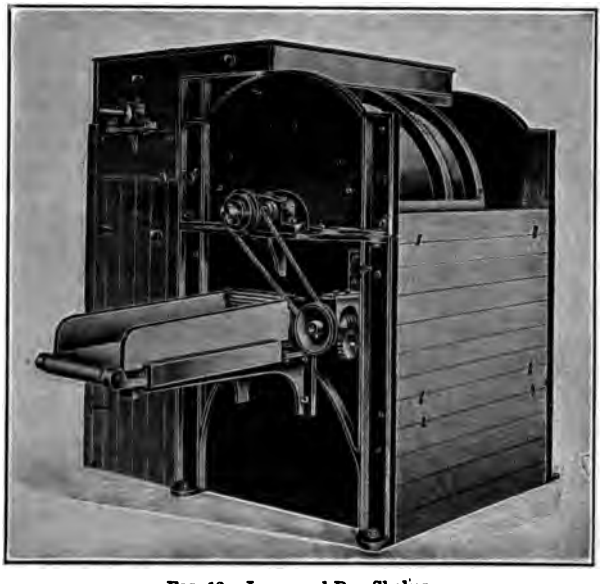

FIG. 12.—Improved Rag Shaker.

that of 262,300,000 pounds of unused wool, pulled wool, mohair, etc., manufactured in 1857 some 35,000,000 pounds, or 13.3 per cent, was shoddy materials, and that of the total of 850,300,000 pounds total in 1907 some 210,000,000 pounds, or 24.7 per cent, was shoddy materials.

The great shoddy manufacturing countries are Germany, Great Britain, the United States, and France, though the industry is also largely carried on in Italy, Belgium, and Switzerland and to a smaller extent in almost every country including China and New Zealand.

A hundred years ago wool waste and old rags were disposed of by burning or by being used as fertilizers, but they now enter largely into the clothing requirements of the world, and by their cheapening effect have done much to popularize woolen clothing for the masses. The increasing use of waste materials and of by-products of manufacture is a sign of the increasing economic efficiency of mankind, and as the world is rapidly becoming more and more crowded the economic use and re-use of all available fibers will become of more and more importance.

EMPLOYEES AND ORIGIN OF INDUSTRY.

The official figures show that in 1895 Germany employed 7,390 persons in the shoddy trade; in 1901 Great Britain employed 4,502, and in 1905 the United States employed 2,261. Owing to the difference in dates and in the methods of compiling this does not give an exact comparison of the strength of the three countries in this industry, but it clearly shows that the industry is largest in Germany and that the second largest is the British, which in turn is about twice as large as the American. From the estimated figures for Great Britain as compared with the tabulated figures for the United States it seems that the amount of shoddy material handled by the operative in each country is very nearly the same—that is, Great Britain uses twice as many operatives to work up twice as much material.

The manufacture of shoddy in Great Britain seems to have started at Batley, in Yorkshire, about 1813. The total consumption is as yet only estimated, but the official import figures dating from 1860 seem evidence enough to prove a steady increase. The import of shoddy materials into Great Britain has been as follows:

	Pounds.		Pounds
1860	16,824,000	1890	77,638,400
1865	32,670,400	1895	84,257,600
1870	38,555,400	1900	68,757,800
1875	56,929,600	1905	91,932,587
1880	92.433,600	1906	99,892,110
1885	73,133,600	1907	113,423,418

It is estimated that nearly as much shoddy material is obtained in Great Britain as is imported. In the last fifty years the proportion of shoddy to the total animal fibers used has increased from about an eighth to a quarter. The proportions for the last ten years, as estimated by the Bradford Chamber of Commerce, are as follows:

Year.	Total animal fibers.	Shoddy.	Shoddy (per cent of total).	Year.	Total animal fibers.	Shoddy.	Shoddy (per cent of total).
	Pounds.	*Pounds.*			*Pounds.*	*Pounds.*	
1898	724,600,000	125,000,000	17.3	1903	625,600,000	140,000,000	22.4
1899	677,200,000	125,000,000	18.4	1904	643,600,000	180,000,000	28.0
1900	654,600,000	130,000,000	19.7	1905	681,700,000	180,000,000	26.4
1901	704,200,000	135,000,000	19.2	1906	734,300,000	190,000,000	25.9
1902	667,000,000	140,000,000	21.0	1907	850,300,000	210,000,000	24.7

The proportion of reworked wool to the total is therefore about 25 per cent, without including the large amount of cotton that is mixed with the shorter qualities to bring up the strength. While very little shoddy is manufactured by itself, cotton, cotton waste, unused wool, or other material nearly always appear in the finished cloth as warp or mixed in the yarn itself. On the other hand, it is admitted in Yorkshire as a well-known fact that there is not produced there a very large amount of woolen yarn that contains only unused wool.

SUPPLY OF RAGS.

Great Britain imports rags from nearly every country in the world as also does Germany, while the United States depends entirely on its home supply. The fact that the American manufacturers are restrained from competition in outside markets enables Great Britain

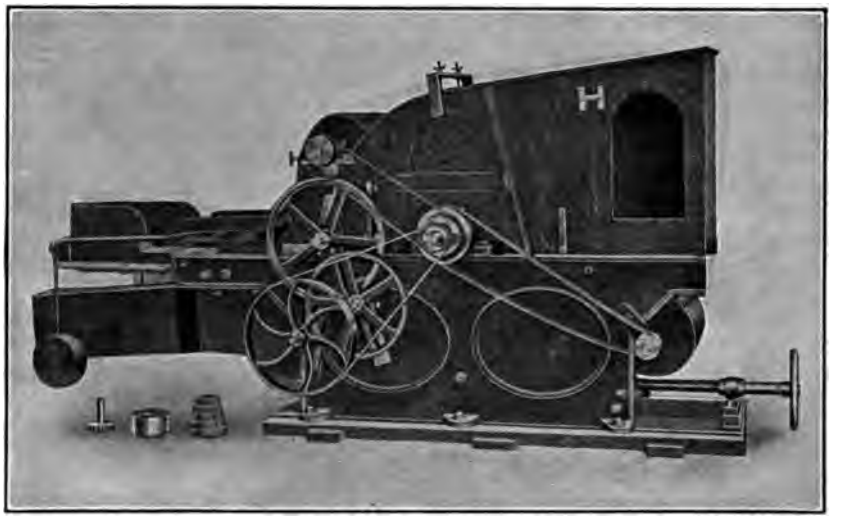

FIG. 13.—Improved Rag Machine or "Devil."

to obtain her rags cheaper than she would otherwise be able to do and also makes the cost of raw material higher to the American manufacturer. Owing partly to this the American shoddy manufacturer seems to mix in higher-grade materials than is customary in Great Britain. American dealers who supply the shoddy mills quote on broken pieces of tops, best soft drawing laps, double-combed noils and similar materials, which in Great Britain rarely come into the shoddy market at all, being worked up direct by the woolen mills. The production census of 1905 shows the average value of the materials used in the American shoddy mills as 6.84 cents a pound. There are no such figures for Great Britain, but the average value of the shoddy materials imported into Great Britain in 1907 was only 4.6 cents a pound, and the materials obtained in the country itself will average probably even lower.

France and Germany supply over half of the rags used in the British shoddy trade and large amounts also come from Holland

Belgium, with smaller amounts from the United States, Russia, Denmark, etc. Nearly every country in the world contributes more or less. At Peshawar, near the Khyber Pass, I found that second-hand clothes from London were being sold to the Afghans, and after being worn to rags part of these were reexported to Great Britain and worked up into shoddy clothes that would be worn probably by the inhabitants of some other quarter of the globe. This is a curious illustration of how the nations are bound together by modern ties of commerce.

EXTENT OF FACTORY OPERATIONS.

Shoddy manufacturing in Great Britain centers in the two neighboring towns of Batley and Dewsbury, which lie in the heavy woolen district in the West Riding of Yorkshire, in northern England. These two places, lying about 1½ miles apart, have almost a monopoly of this trade, and of the 908 rag machines in Great Britain in 1904 no less than 881 were to be found in Yorkshire, the bulk of these being in this heavy woolen district. Of the 908 rag machines employed in this industry 566 were in the regular shoddy mills, 329 were employed in woolen mills, and 13 in worsted mills. The extent to which shoddy is used in the woolen trade is evidenced by the number of rag-grinding machines employed by woolen mills and also by the fact that the bulk of the so-called "shoddy mills" only prepare the material for use in woolen mills. Of 161 shoddy mills in 1904, only 23 contained a complete equipment for preparing, spinning, and weaving shoddy, 2 had looms only, 4 had spindles only, 22 had rag-grinding machines and carding sets, and 110 had rag-grinding machines only.

The 1904 statistics of the British Government listed only the machinery, while the latest figures in regard to the operatives are those of 1901. The progress of the industry and its fluctuations are partly shown by the following:

	1867.	1874.	1885.	1889.	1904.
Shoddy mills	108	125	108	125	161
Rag-grinding machines	.....	.....	.....	.....	566
Woolen carding sets	.....	.....	.....	.....	319
Spinning spindles:					
Mules	7,319	101,134	93,766	94,404	73,418
Frame	.....	.....	.....	.....	400
Doubling spindles	4,228	946	2,222	691	2 520
Power looms	1,095	1,437	1,981	2,284	1,432
Children working half time:					
Male	140	187	67	84	.....
Female	72	135	25	50	.....
Persons working full time:					
Male	1,398	1,384	1,832	2,138	.....
Female	1,585	1,725	2,785	2,231	.....
Total persons employed	3,195	3,431	4,709	4,503	.....

It is seen that very few children are employed in this trade and that there are more men than women, which in both instances is also true of the woolen trade, while in the worsted trade women and girls form the bulk of the operatives.

Besides the rag machines employed in making shoddy in shoddy, woolen, and worsted mills there are 103 rag-grinding machines and

225 carding sets employed in 67 factories in which felt and flock processes are carried on. These factories are mostly situated in Gloucestershire and London.

CLASSIFICATION AND ASSORTMENT.

Shoddy is a term that is frequently used to cover the whole range of remanufactured wool. However, in the trade there are many names used, and shoddy is only one special class. Shoddy is technically the product of unmilled goods and "mungo" is the product of milled or felted goods. The first results from tearing to pieces, or "pulling," as it is called, soft woolen rags, stockings, underclothing, and similar soft woolens. Mungo is usually made from hard woolens, tailors' clippings, etc. Mungo is therefore made of shorter stapled, finer, and higher-priced material than is shoddy. "Extract," sometimes called alpaca, is made from mixed cotton and woolen cloths, the vegetable fibers being carbonized or burned away by acids and the animal fibers thus extracted for reworking. "Merino" is a more

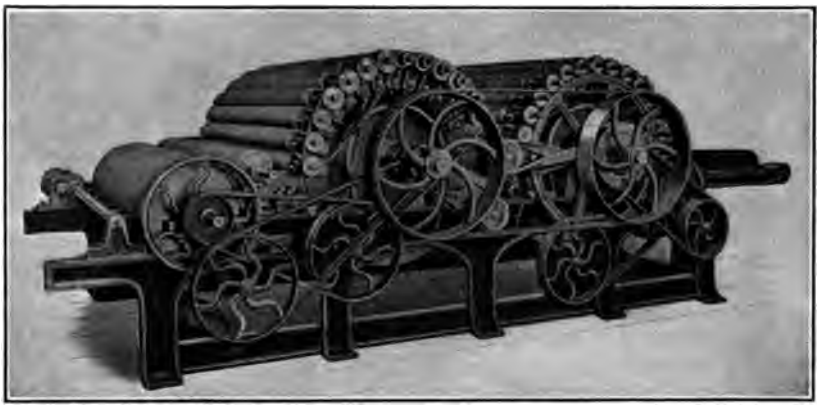

FIG. 14.—Two-Swift Garnett Waste Opener.

popular name than shoddy, but is only one of its subdivisions, being used to denote the rag wool made from women's dress goods and similar soft worsted materials of good quality. "Worsted," "serge," "flannel," etc., are other names of rag wools that are commonly used in the trade and derive their names from the goods in which they were originally embodied. The better grades of shoddy are considerably more valuable than the lower grades of wool and are used to improve the surface of some of the finer cloths, such as those used for expensive smoking jackets, etc., and quite a little in facing some of the celebrated West of England cloths. Shoddy has become a term of reproach, even in its home in Yorkshire, so that merino is now frequently used as the generic name instead. The French in politely terming shoddy goods "renaissance cloth" have found the most correct name of all.

In the commercial handling of the rags and of the rag wool before finally weaving into cloth in England, there is a highly organized trade system, admitting, however, of many variations. Ordinarily the

handlers from "cloth to cloth" are as follows: (1) the itinerant rag gatherer; (2) the marine-stores dealer in small towns; (3) the marine-stores dealers at London or other large town; (4) the rag sorter or shoddy dealer; (5) the rag puller or shoddy manufacturer; (6) the woolen-cloth manufacturer. In former days the itinerant rag gatherers frequently sold to small mills, but the trade has gotten too highly specialized for that now, and with the many types and grades required middlemen have become a necessity. He sells to the local rag dealer or "marine-stores dealer," as he is usually called, and this man may sell a special lot he has collected direct to a shoddy maker, though ordinarily he sells to larger dealers in London or elsewhere, who collect large quantities and sort into general classes, according to whether the rags are new or old, all wool or cotton and wool, etc., and then sells special lots to rag sorters or shoddy merchants, as they are called. These men sort the rags according to type of cloth, grade, color, etc., and then sell specific lots by sample to the shoddy mills. As previously noted, the main business of the shoddy mills is making shoddy, not working it up, so after one more careful sorting the rags are pulled by the shoddy maker, and then the material in its original raw fiber state is sold to woolen manufacturers for manufacturing into cloth.

BUYING AND WORKING UP RAGS.

From abroad the rags are imported by merchants in the heavy woolen district or occasionally by the manufacturers themselves direct. If imported by the merchant, he may sell to another merchant those of a certain type, or to a large puller, or may sell at the auctions. There are five houses in Batley that carry on weekly rag auctions in the same way that wool auctions are carried on in London. The rags sold may be the property of the house selling or may be with them on consignment from abroad or from another merchant. The man who owns the rag-pulling machines, therefore, may either buy direct or through many other hands, according as it suits him.

There are a few firms at Batley who pull, carbonize, and even card on commission, but this is the exception and there is comparatively little of this class of work. The bulk of the pullers buy their own rags from the rag sorters, already sorted according to the classes they desire, then re-sort carefully, once at the mill for staple, color, etc., and then tear up into their original fibers on the rag machine, finally selling each uniform lot separately to the woolen mills. Some of the large shoddy makers card the rag wool after pulling, and some buy rags and turn out finished goods ready for the market, though two-thirds of the shoddy mills have rag machines only.

In a complete shoddy mill—which, as before noted, is very rare—the following would be the list of processes: Rag shaking, extracting, dyeing, sorting, oiling, pulling (or garnetting), blending and oiling, teasing and tenterhook willeying, carding, spinning, weaving, scouring, raising or milling, finishing, and pressing.

Whether the rags go through all or only part of these processes depends entirely on the quality of the original cloth and the kind of goods to be made therefrom. "All-wool" cloths will of course not be subjected to the extracting process. If the rags are of a uniform color, say a good lot of ladies' blue serges, they can be run through and used to make yarn of the same color without redyeing, but if

part of them are faded they will need to be redyed. Rags are run through the rag machine, or devil, and mill waste through a garnetting machine. Blending, teasing, or willeying may or may not be required. The finishing processes will vary according to the kind of goods. There are many variations, so that the cost of working one lot of rags may be several times as much as the cost of working another lot.

I will briefly describe the machines as used in the Batley and Dewsbury shoddy mills and then give the complete detailed first cost and operating cost of a forty-loom shoddy mill making low tweeds. [A sample of this cloth may be seen at the Bureau of Manufactures.]

SORTING AND OILING.

The foreign rags arrive at the shoddy mill in hooped bales weighing 6 to 8 hundredweight (English hundredweight = 112 pounds), while

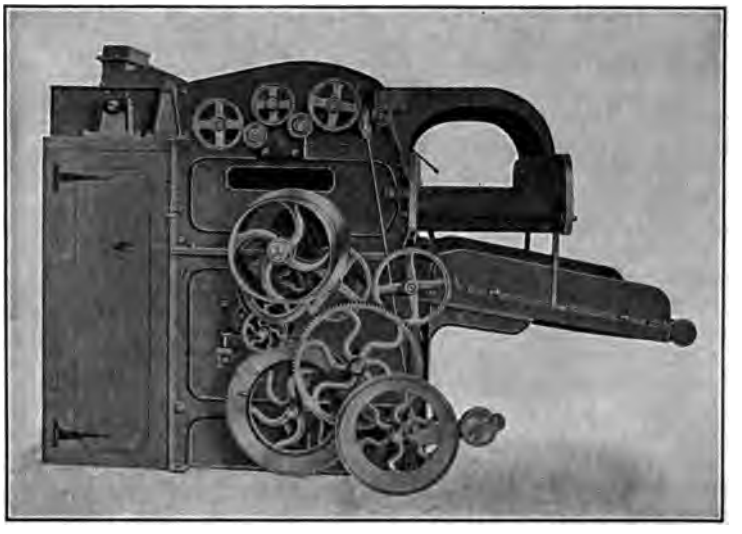

FIG. 15.—Improved Self-acting Shake Willey or Teazer.

the British rags usually come in sacks weighing about 140 pounds each. The contents of each sack are first run through a rag-shaking machine to remove the dust, dirt, etc., and make them better for handling. They have been through several sortings before arriving at the factory and are in a fairly well sorted state, as each manager tries to buy as uniform lots as possible of the special type he requires, to save work at the mill. There is always, however, one final sorting according to staple, color, etc., at the mill before oiling and pulling. This sorting is usually done by women, who open up one of the large sacks in which the rags come from the rag-shaking machine and throw the different kinds and colors into adjacent sacks. Owing to the many different grades sorted at the ordinary mills these women are not usually paid by piecework, but by the week. They average 12 to 15 shillings ($2.72 to $3.65) a week, though sorters on high-class work may make up to 20 shillings ($4.86) or over. Rags are only

washed in exceptional cases. If necessary to dye, the dyeing is done before the rags are torn up.

After the rags have been shaken and sorted each pile is spread out on the stone floor in a space about 10 feet square and oiled, using an equal amount of oil and hot water and spraying it on with a can by hand. Usually in the rag trade black or brown oil that has been recovered by squeezing oily wool waste is used, in the proportion of 5 to 10 per cent of oil to the weight of material worked. For high-class shoddy more costly grades of oil are substituted. The oil facilitates the working of the materials and incidentally it also decreases the cost of pulling by reason of the weight added; for, after allowing for a certain amount of evaporation and loss in the process, the resulting shoddy will weigh more than the rags out of which it was made. The water also adds to the weight, but the exact amount of water (which should always be hot) to be added varies according to the class of material, being usually equal in amount to the oil. After one bag of rags is spread out and oiled another set of rags is laid on top and oiled, and so on until five or six bags of rags have been spread on and oiled, when the material is ready to be pulled. The rag-machine minder, starting from one side of the pile and working down from top to bottom, so as to get a uniform mixing, feeds the oily mass of rags onto a lattice, which carries it into the rag machine, where it is torn up into its original fibers and thrown out into a pile ready for remanufacture at the shoddy mill or for sale to a woolen manufacturer. This pulled rag wool is rarely worked by itself, but is mixed with pure wool, with noils, cotton, cotton waste, or some other material to give it strength. After this mixing with other materials, which is by spreading out in alternate layers of shoddy and the mixing material, the mass is usually fed through a teazer and then a "fearnaught" to clean and mix more thoroughly, and is then sent to the card room. Here it is put in the hopper of a scribbler, going then to the carder and then to the mule and the loom.

DUSTER AND DEVIL.

The rag shaker or duster, the first machine used in a shoddy mill, is very simple. It consists of a 36-inch drum or swift, with six rows of pegs, revolving in an inclosed box at a speed of about 400 revolutions per minute. A fan is attached to draw out the dust, etc. A quantity of rags is put in and left for five to fifteen minutes to the action of the revolving pegs and the fan. The door is then opened and the rags replaced with a new set.

The rag machine or devil is equally as simple. The standard machine consists of a wood-lagged drum, usually 36-inch diameter and 18-inch face (some are only 14 inches wide and some 20 inches), revolving in an inclosed box. As the rags are fed in by a moving lattice and feed rolls they are struck by the pins or teeth inserted in the drum and are torn apart and pulled until reduced to a fibrous mass, and this torn material or "shoddy," as it is henceforth called, is delivered from the front of the machine under the feed table. This is the arrangement universally adopted in England, as in this case there is nothing to impede the output. A fan at the base of the machine assists the draft and delivers the material evenly and regularly as it is torn up.

As sometimes small pieces of rags pass through the machine insufficiently torn, some have what is called a patent bitter roller motion to prevent this. It is in the shape of a small roller with teeth, above the regular spiked drum, and catches the untorn pieces and tosses them back automatically upon the feed table to be repassed through the process. The material is fed by the feed rollers to the action of the spiked cylinder at the rate of 20 inches per minute for merino and 30 inches per minute for shoddy or hosiery. The work of this spiked cylinder at a high speed is so heavy that the spikes have to be renewed every four to five months and an extra cylinder has to be kept on hand ready for substitution. The number and arrangement of the spikes and the speed depend on the quality of the material to be pulled, and the production

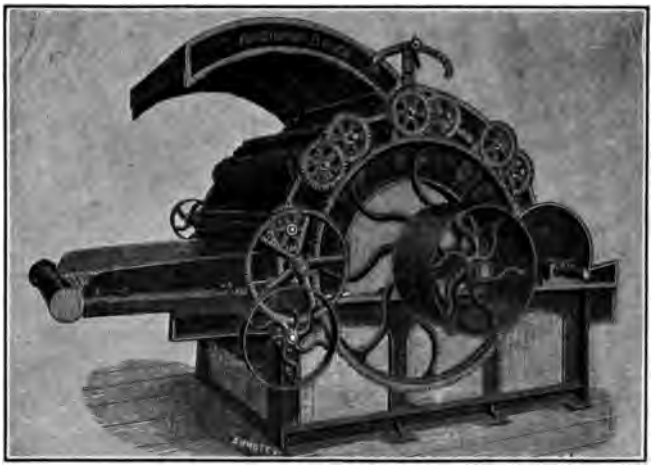

FIG. 16.—Fearnought.

varies accordingly. One large maker gives me the speed and production of his rag machines, as follows:

	New cloth or mungo.	Old cloth or mungo.	Merinos.	Berlins.	Flannels.	Shoddy.
Revolutions per minute	750	750	500	350–400	300–500	300–500
Hundredweights per 10 hours	7	8	7	13	7	11–12

OPERATING AND MACHINE COSTS—GARNETING.

The devil-minder is usually paid 22 shillings ($5.35) a week, but the work required of him and also the production according to the different classes of material vary, so that the unit wage cost of pulling may vary anywhere from one-sixteenth of a cent to over one-half a cent a pound. If hard and soft materials are both to be run on the same devil, extra spiked drums, pulleys, feed rolls, etc., are required, so as to deliver and work the softer material at a more rapid rate. The rag machine or devil usually requires 5 to 6 horsepower to operate, weighs some 30 hundredweight, and requires an

overall space of 5 feet 8 inches by 11 feet. A large maker gives me his present prices, as follows (£1 = $4.86):

Size.	Cost.		With bitter.		With bitter and fan.	
	Iron cover.	Wooden cover.	Iron cover.	Wooden cover.	Iron cover.	Wooden cover.
18 inches wide	£32	£32	£36	£33	£38	£34
14 inches wide	30	28	32	30	34	32

Extras for loose pulley, stud, and stand, £3. Extras for rag machine bed slide, £6 to £10.

For opening wool spinning waste and similar material the Garnett machine is usually employed instead of the devil. This is really a woolen card, but instead of wire teeth set in vulcanized rubber clothing it has hard steel toothed endless saw blades that are wound on the cylinder spirally similar to the small "lickin-in" used on cotton cards. This machine usually has two 36-inch cylinders and two 24-inch doffers, two 12-inch fancys with ordinary clothing and eighteen 6-inch workers without strippers, but is made with modifications according to the particular work required of it. The swifts are usually run at 285 revolutions per minute. A 2-swift machine 36 inches wide, at 285 revolutions per minute, will turn off about 180 pounds of material if fed with warp waste, cotton hosiery clippings, and cotton cop wastes, and would require 4½ horsepower. The same machine, with same material, 48 inches wide, produces about 240 pounds, and if 60 inches wide about 300 pounds, per ten-hour day.

SCRIBBLING AND BLENDING.

Rag wool from the rag-pulling machine or the Garnett may be taken straight to the scribbler, but in most cases it is desired to blend it with other material, and in this case it first goes through a self-acting teazer or willey, and if thorough blending is desired through another machine called the "Fearnaught" or tenterhook willey before being carded.

In such case the materials from the devil and the Garnett machine may be mixed with each other or with cotton or other material by making piles on the floor as before, also usually again oiling, and this mass is then put on the feeding lattice of a teazer. The material feeds intermittently into a chamber, where it is opened and blended together by the action of the teeth on a rapidly revolving drum carrying it between the teeth on three smaller overhead drums. The big cylinder usually has eight pairs of 3-inch teeth and runs at 500 revolutions per minute, while the three small cylinders usually have six rows of 3-inch teeth and run at 30 revolutions per minute. The heavy dust falls to the bottom and the light dust is carried away by an exhaust fan. The material itself falls on to another moving lattice and is delivered at the side. Such a machine will cost about £82, or $399.

For thorough blending the material as delivered from the teazer is put on a moving lattice and fed into the Fearnaught. This machine consists of a 36-inch cylinder covered with short curved teeth which

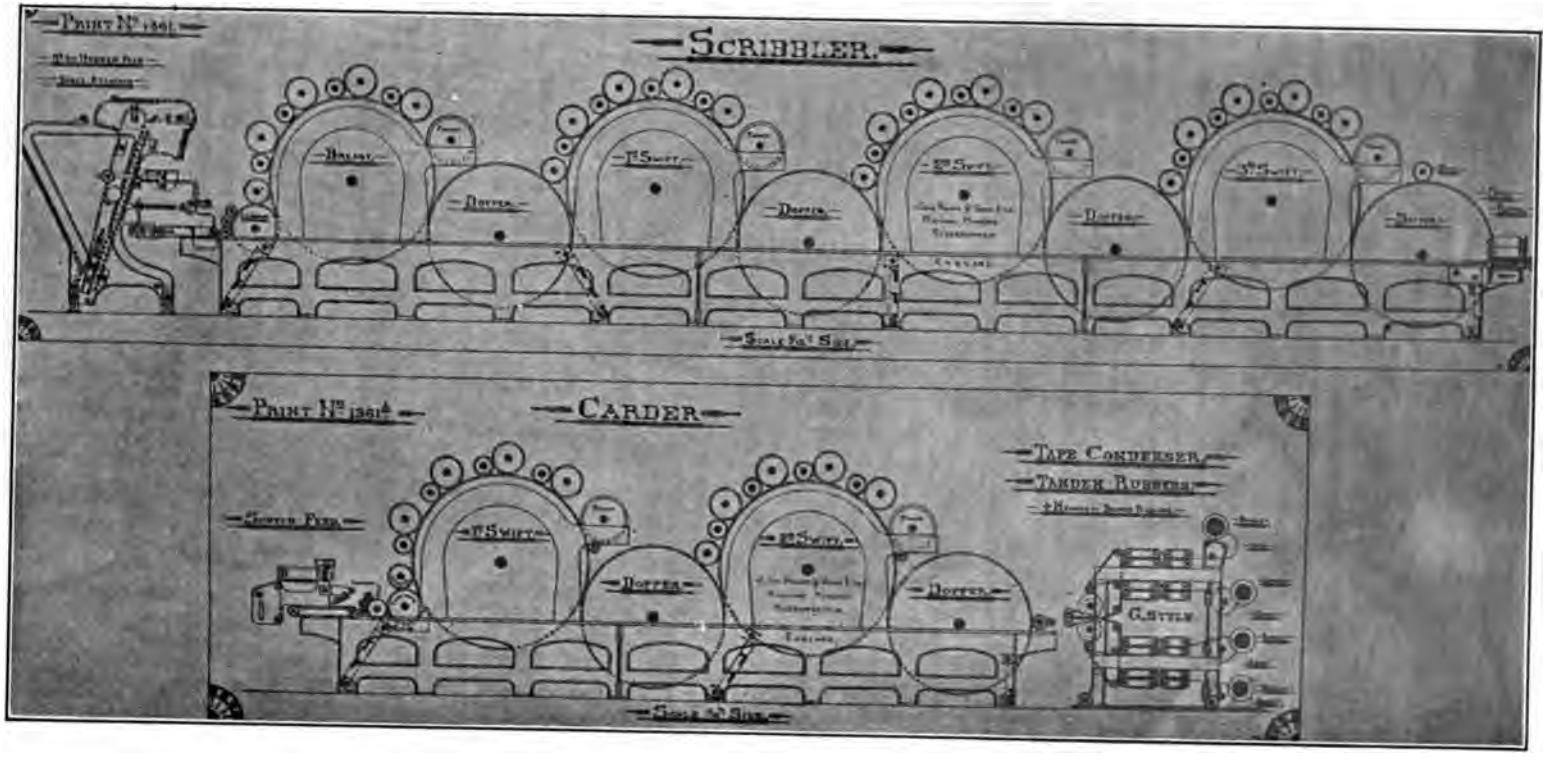

FIG. 17.—Set of Carding Machines for Shoddy.

card out the material, and aids the blending, by the action of the cylinder teeth in conjunction with those of 6-inch workers on its top, there being a 5-inch stripper clearing each worker. An 18-inch fan, revolving at 760 to 960 revolutions per minute, by its suction action delivers the blended mass at the other end of the machine. The material comes into this machine between 4-inch feed rolls revolving at 12 turns to the minute. The cylinder runs from 160 to 240 revolutions per minute, according to the class of material, the workers similarly from 10 to 12 and the strippers from 550 to 700. The action of the teazer is intermittent, but the action of the Fearnaught is continuous. The material is only partially blended by the teazer, as the widely set teeth carry it between other widely set teeth on the workers and so do not open out the individual locks. The Fearnaught, however, with its close-set teeth brushing the material close past—not between—the close-set teeth of the workers has a carding action that is really essential for thorough blending. Sometimes the Fearnaught has an oiling attachment, which can only be used where the blend is of all-animal fibers, for the reason that oil, while essential for work with wool and remanufactured wool, is detrimental to cotton. Where cotton and wool materials are to be worked, the best shoddy makers run the unoiled cotton and the oiled shoddy and wool, etc., through the teazer separately and then mix and run together through the Fearnaught. The Fearnaught with oiling attachment and delivery fan costs about £132 ($643)

THE CARDING OPERATIONS.

After blending, the material is carried to the card room. Here it is run through the scribbler and then the carder and condensed into slivers for use on the mule. These machines are very large and are 60 to 72 inches wide. Automatic hoppers are used on the scribbler and these have no bottom lattice, so that the sloping feed lattice forms an acute angle with the back of the box. The material is delivered into a weighing trough which automatically dumps it onto the delivery lattice. The trough that turns over is usually preferred to the type that opens out. The scribbler for low-class work has a large amount of carding surface, so that there are usually three or four cylinders and doffers besides a breast. Ordinarily the breast is 48 inches in diameter and its doffer 40 inches, while the swifts or cylinders are 50 inches in diameter and their doffers 44 inches. The first workers have saw teeth, but the machine as a whole is similar to the ordinary woolen scribbler. The blanket or Blamires feed is ordinarily used. In this case the material is delivered on a slide in layers and is rolled up on the side into laps 60 inches long and then two of these put behind the carder.

Some manufacturers prefer the automatic Scotch feed by which the material is drawn into a ribbon and then arranged in order on the back feed of the carder, the two machines in this case working as one. One large manufacturer says that his experience has been that the Scotch feed is preferable for the finer qualities weighing less than 100 yards per ounce, but that for the heavier slivers there is not strength sufficient to hold together in the ribbon form while being dragged over the automatic feed, and that for such work the Blamire feed is much better and is usually employed. The carder usually consists of two

50-inch cylinders and two 44-inch doffers. The type of condenser varies. The double ring doffer is not much used and ordinarily it is the single ring doffer with double rubber condensers making two sliver laps that is in use The tape condenser is coming more and more into use, especially for the better class of work, and usually makes 100 slivers, or allowing for the waste slivers, four condenser laps of 24 slivers each. The price per set is very variable according to the different types, but for a set consisting of a scribbler with automatic bin feed, breast, and three swifts, with Blamires feed, and a carder of two swifts and tape condenser with four laps the present price is about £523, or $2,545. Usually one girl at 14 shillings ($3.41) a week runs two scribblers and another girl at 15 shillings ($3.65) a week the two carders, while one card fettler at 20 shillings ($4.86) a week has the care of adjusting and keeping up the two sets.

MULE SPINNING AND OPERATORS.

The mules are usually from 375 to 440 spindles each and cost about 7 shillings 6 pence ($1.82) a spindle. The lap as it comes from the condenser with 24 slivers rolled up on it in adjacent cheeses is laid in at the back of the mule and each sliver passes under one roll only and goes to the spindle. The single set of rolls rotates intermittently. The mule as used for shoddy is similar to the woolen mule, but differs from the mules as used for worsted and cotton in that there is no roller draft, but only spindle draft, and also in the fact that the spindles are square ended instead of pointed, which latter fact seems to add to the fullness and softness of the yarn by the vibration the end receives as it slips off the square spindle top when twist is being inserted. On ordinary work two sets of cards supply two pairs of mules.

The number of operatives required varies greatly according to the quality of material and counts being spun, but for 34 yards to the dram yarn being made from a good grade of shoddy there is ordinarily required for two pairs of mules of 1,760 spindles total one main piecer at 26 shillings ($6.32), two piecers at 18 shillings ($4.36), and one boy at 11 shillings ($2.68) per week. There is comparatively little indirect payment, as it has been found that where the main piecer is allowed to hire his own help he frequently gets too cheap labor.

WEAVING COSTS.

After spinning the yarn goes to the loom where it is woven. In most of the work the warp is not sized unless it is specially tender. The shoddy is more often used for weft than warp. Much of it is twisted before being woven, frequently a fine cotton being twisted with the soft shoddy thread to give strength. The warp is usually "cheesed" on a drum winder, run off on a Scotch warping mill and then onto loom beams over the Yorkshire dressing frame, though there are many different types of warp-preparing methods. The weft is usually prepared direct for the shuttle by running into cops of the correct size on a cup winder.

The looms used in the shoddy trade are of the heavy woolen type and are practically all over 60 inches wide, being ordinarily 85 or 90

inches wide and one weaver running one loom. The standard speed is 80 picks to the minute. This depends on the material, some being run at 100 and even up to 120 picks per minute for certain classes of work. The weavers are paid by piecework, but the materials that are used are so diverse that the piecework wages are equally diverse and can not be averaged. One of the largest Batley shoddy manufacturers who used shoddy filling and various types of warps gave me his present (October 4, 1908) weaving schedule as follows, prices being those paid weavers per cut in American currency:

Weaving schedule at Batley shoddy mill.

FAST LOOMS (100 PICKS PER MINUTE).

Cotton warps.					Worsted warps.					Woolen warps.					Worsted or cotton warps.				
Picks per inch.	Yards per cut.	Beams.	Shuttles.	Price per cut.	Picks per minute.	Yards per cut.	Beams.	Shuttles.	Price per cut.	Picks per minute.	Yards per cut.	Beams.	Shuttles.	Price per cut.	Picks per minute.	Yards per cut.	Beams.	Shuttles.	Price per cut.
36	90	1	2	$2.43	34	100	2	2	$3.036			*Plain.*					*Cotton warps.*		
38	90	1	2	2.55	36	100	2	2	3.159	17	106	1	1	$1.395	38	90	1	1	$2.367
40	90	1	2	2.673	38	100	2	2	3.279	17	120	1	1	1.578	40	90	1	1	2.490
42	90	1	2	2.793	40	100	2	2	3.402			*Checks.*			42	90	1	1	2.610
44	90	1	2	2.916	42	100	2	2	3.522	17	106	1	2	1.578	44	90	1	1	2.733
46	90	1	2	3.036	44	100	2	2	3.641						46	90	1	1	2.853
48	90	1	2	3.159	46	100	2	2	3.761						48	90	1	1	2.976
50	90	1	2	3.279	48	100	2	2	3.888								*Worsted warps.*		
52	90	1	2	3.402	50	100	2	2	4.008						28	100	1	1	1.944
54	90	1	2	3.522	52	100	2	2	4.131										
56	90	1	2	3.645	54	100	2	2	4.251										
58	90	1	2	3.765	56	100	2	2	4.374										
60	90	1	2	3.888	58	100	2	2	4.494										
Rise and fall, 12 cents per 2 picks. Extra shuttle, 24½ cents. Extra beam, 24½ cents.					Rise and fall, 12 cents per 2 picks. Extra shuttle, 24½ cents. Extra beam, 24½ cents.					Rise and fall, 6 cents per pick. Plain woolens, extra shuttle, 12 cents.					Rise and fall, 6d. (12 cents) per 2 picks.				

SLOW LOOMS (80 PICKS PER MINUTE).

36	90	1	2	$3.036	32	100	1	2	$3.199			*Plain.*					*Cotton warps.*		
38	90	1	2	3.159	34	100	1	2	3.359	17	106	1	1	$1.578	38	90	1	1	$2.793
40	90	1	2	3.299	36	100	1	2	3.522	17	120	1	1	1.821	40	90	1	1	2.916
42	90	1	2	3.442	38	100	1	2	3.685			*Checks.*			42	90	1	1	3.036
44	90	1	2	3.582	40	100	1	2	3.845	17	106	1	2	$1.821	44	90	1	1	3.159
46	90	1	2	3.725	42	100	1	2	4.008						46	90	1	1	3.279
48	90	1	2	3.865	44	100	1	2	4.171						48	90	1	1	3.402
50	90	1	2	4.008	46	100	1	2	4.331								*Worsted warps.*		
															28	100	1	1	2.43
Rise and fall, 14 cents per 2 picks. Extra beam, 36½ cents. Extra shuttle, 24½ cents.					Rise and fall, 16 cents per 2 picks Extra beam, 36½ cents. Extra shuttle, 24½ cents					Rise and fall, 6 cents per pick. Plain woolens, extra shuttle, 12 cents.					Rise and fall, 12 cents per 2 picks.				

FINISHING—NUMBERING REEDS—NO CONTAGION.

After weaving the cloths are finished in the same way as woolen cloths, there being many different methods, and the resulting goods are usually sold as cheap woolens.

Shoddy yarns are numbered the same as woolen, that is in weight per length, but while woolen yarn counts are usually given according to

the number of 1,520-yard skeins or hanks in a "wartern" of 6 pounds, the shoddy yarns in the Batley and Dewsbury district—as are also heavy woolen yarns—are designated by the number of yards to the dram. The two are practically identical for ordinary counts, as the skein contains 1,520 yards and the wartern of six pounds is 1,536 drams.

The reed or slay in the Dewsbury shoddy trade is numbered according to the number of beers of 38 warp ends in 90 inches, slayed two in a dent. As a matter of contrast it may be noted that reeds on the Continent are numbered according to the dents in one centimeter; in the United States and in Huddersfield according to the number of dents in one inch; in Bradford according to the number of porties in 36 inches, slayed 4 in a dent; in Leeds according to the number of beers of 38 warp ends in 9 inches, slayed 2 in a reed, etc. In this, as in many other textile matters, such as counts, etc., there is more confusion of customs and more variety of trade terms in Great Britain than in all the rest of the world put together, and so jealous is each section of every other that no one is willing to sacrifice its own method of nomenclature in order to secure uniformity.

As it is sometimes claimed that it is dangerous to wear clothes made of shoddy for fear they may spread contagious diseases, it may be noted that official investigations in the English shoddy district have shown that while the men operating the rag machines sometimes suffer from an influenza called "shoddy fever," caused by breathing the irritating dust produced by the devil, that it has been proved that there is no record of any of the thousands of workers having contracted any contagious disease from handling this material. Only a small portion of the rags handled are carbonized or washed, but as the cloth made therefrom goes through a good many washings in the scouring and finishing processes the finished material is no more liable to spread disease than similar goods made from pure wool.

COMPLETE MILL ESTIMATE.

COST OF SHODDY PLANT PRODUCING LOW TWEEDS.

The complete detailed first cost and working costs of a 40-loom mill to make shoddy tweeds like the sample furnished to the Bureau of Manufactures and also pictured in Fig. 18 is as follows:

For a plant of forty 4-box 90-inch looms, cloth to be produced (as per sample forwarded) is made with 28 warp ends per inch of width and 27 picks of filling per inch of length. The warp (twist) is 13-skein yarn and the filling 9-skein yarn. The cloth is woven 66 inches wide for a finished width of 56 inches. It weighs 21 ounces per yard (37-inch yard in length, 56 inches wide), and the manufacturers' selling price is 1s. 6½d. or 37.3 cents per 37-inch yard. As will be shown in subsequent tables in detail the present manufacturing cost is 35.8 cents per yard, leaving the manufacturer only 1.5 cents per yard profit at present (October, 1908) prices.

FIG. 18.—Low Shoddy Tweed.

The production of 40 looms working at 80 picks per minute for 54 hours per week, 50 weeks in the year, allowing 35 per cent for stoppage, is 334,286 yards per year, which is, say, 5,000 pieces (each piece sixty-five 37-inch yards long) per year, or 100 pieces per week.

Material required.	For 1 piece.	For 5,000 pieces.
	Pounds.	*Pounds.*
13-skein warp for twist	42	210,000
9-skein weft	55	275,000
1/30s. cotton for twist	6¾	33,750
Total yarn required for one piece	103¾	518,750
Total weight of finished piece	85½	.....
Waste in working, scouring, etc	18¼	.....

Figuring on the plant required to produce 210,000 pounds of 9-skein weft and 275,000 pounds of 13-skein twist, on the 40-loom basis, the first costs and the working costs in detail are considered under the following departmental heads:

(1) Mill buildings.
(2) Steam for engine, heating, etc.
(3) Motive power.
(4) Rag pulling and carbonizing.
(5) Carding and spinning, including teazing and willeying.
(6) Winding and twisting.
(7) Warping and beaming.
(8) Weaving department, including putting up.
(9) Perching, mending, knotting, and burling.
(10) Scouring and finishing.
(11) Warehouse and selling.
(12) Office and financial charges.
(13) Pattern making.
(14) Detailed costing.

(1) MILL BUILDINGS FOR 40-LOOM MILL.

Capital expenditure: Main building, 3 stories, 3,000 square yards total floor space. Ground floor for engine, scouring and finishing machinery. First floor for carding machinery. Second floor for spinning and twisting machinery.

Weaving shed, 1 story, 1,500 square yards, for winding, warping, beaming, and weaving machinery.

Dyehouse and carbonizing plant.

Shed for rag pulling and teazing machinery.

Shed for stores, etc.

Offices

Cost of above 6,000 square yards floor space about £10,000 ($48,665).

Departmental costing:

	£	s.	d.	
Interest and sinking fund (50 years) on £10,000, at 4½ per cent	506	0	10=	$2,462.65
Ground rent	80	0	0=	389.32
Repairs, etc	100	0	0=	486.65
Insurance and taxes on buildings	47	10	0=	231.16
Steam for heating	86	0	0=	418.52
Miscellaneous expenses	25	0	0=	121.66
Total	844	10	10=	4,109.96

This figures out at about 2 shillings 10 pence (68.6 cents) per square yard per annum.

(2) STEAM DEPARTMENT.

Capital expenditure:	£	s.	d.	
Boiler house and chimney	1,050	0	0=	$5,109.82
Two Lancashire boilers 30 by 7 feet	800	0	0=	3,893.20
Seating for boilers	300	0	0=	1,459.95
Connecting steam and water pipes	75	0	0=	364.99
Total	2,225	0	0=	10,827.96

Departmental costing:

Interest and sinking fund (13 years) on £1,175, at 4½ per cent	121	0	4=	$588.93
Interest and sinking fund (14 years) on £1,050, at 4½ per cent	57	0	2=	277.44
Repairs	30	0	0=	146.00
Rates, taxes, gas, insurance	46	10	0=	226.29
Ground rent	5	0	0=	24.33
Water, 3,462,000 gallons, at 7d. per 1,000 gallons	100	19	6=	491.39
Coal, 1,910 tons per annum, at 7s. 6d	716	5	0=	3.485.63

Departmental costing—Continued.	£	s.	d.	
Wages for stoking, flue cleaning, etc. (1 man at 25s. and occasional helps)	66	8	0=	$323.13
Miscellaneous expenses	10	0	0=	48.66
Total	1,153	3	0=	5,611.80

Total indicated horsepower on engine with above plant, 673. Therefore cost per indicated horsepower per annum is £1 14s. 3¼d. (say, £1 15s., or $8.51).

(3) MOTIVE-POWER DEPARTMENT.

Capital expenditure:	£	s.	d.	
1 compound condensing vertical engine, 250 indicated horsepower	1,200	0	0=	$5,839.80
Metallic packing and sheeting, fly wheel	35	0	0=	170.33
Fixing engine	50	0	0=	243.33
Ropes	48	0	0=	233.59
Shafting, couplings, hangers, etc	400	2	0=	1,946.64
Gear wheels, pulleys, belts, etc	215	0	0=	1,046.30
Miscellaneous	51	18	0=	253.01
Total	2,000	0	0=	9,733.00

Departmental costing:				
Interest and depreciation (13 years) on £2,000, at 4½ per cent	206	10	10=	1,005.13
Repairs	34	0	0=	165.46
Rent, rates, taxes, gas, insurance	26	4	6=	127.62
Water for condensing, oil, packing, tallow, etc	40	0	0=	194.66
Wages, 1 engine tender, at £2 per week	104	0	0=	506.12
Steam, 250 indicated horsepower, at £1 15s. per indicated horsepower	437	10	0=	2,129.09
Miscellaneous	10	0	0=	46.86
Total	858	54=		4,176.94

Cost per indicated horsepower, £3 8s. 8d. (say, £3 10s., or $17.03).

(4) RAG PULLING AND CARBONIZING.

Capital expenditure:	£	s.	d.	
2 rag-pulling machines, at £35	70	0	0=	340.66
1 extra cylinder, at £13	13	0	0=	63.26
Fittings and belting	10	0	0=	48.67
Carbonizing plant and fittings	20	0	0=	97.33
Miscellaneous	7	0	0=	34.06
Total	120	0	0=	583.98

Departmental costing:				
Interest and sinking fund (13 years) on £120 at 4½ per cent	12	8	0=	60.34
Rent, 70 square yards, at 2s. 10d	9	18	4=	48.25
Rates, taxes, gas, insurance	10	0	0=	48.66
Motive power 20 indicated horsepower, at £3 10s	70	0	0=	340.66
Repairs	5	0	0=	24.33
Materials	3	0	0=	14.60
Labor, 50 weeks, at 35s. per week	87	10	0=	425.82
Miscellaneous expenses	5	0	0=	24.33
Total	202	16	4=	987.00

Production, 500,000 pounds per annum. Cost per pound, 0.1 pence (0.2 cent).

(5) CARDING AND SPINNING.

	£	s.	d.	
Capital expenditure:				
8 sets of cards, each set consisting of automatic bin feeder, 3-swift scribbler with Blamire feed, and 2-swift carder with tape condenser for 100 slivers, at £523 per set	4,184	0	0=	$20,361.44
2 extra doffers	18	0	0=	87.60
Leather belting, £90, and grinding frame, £23	113	0	0=	549.91
4 emery rollers	18	0	0=	87.60
Condenser bobbins	19	4	0=	93.43
Wrought-iron pulleys	16	0	0=	77.86
1 self-acting teazer	82	0	0=	399.05
Pulley and belt for teazer	5	0	0=	24.33
One Fearnought with oiling machine and delivery	132	0	0=	642.38
Pulley and belt for Dreadnought	5	0	0=	24.38
5 pairs self-acting mules, 375 spindles each 2½ inches pitch, 78-inch draw, 19-inch spindles, 3,750 spindles; total, at 7s. 6d. (spindle speed, 600 revolutions per minute)	1,406	5	0=	6,843.51
Brass buttons for spindles, £31 5s.; belting, ropes, etc., £70	101	5	0=	492.73
Weft bobbins, £12, and miscellaneous, £150	162	0	0=	788.37
	6,261	14	0=	30,472.56
Card clothing for 8 sets, at £210 per set	1,680	0	0=	8,175.72
Total	7,941	14	0=	38,648.28
Departmental costing:				
Interest and sinking fund (14 years) on £6,300, at 4½ per cent	616	5	8=	2,999.14
Interest and sinking fund (6 years) on £1,680, at 4½ per cent	325	14	2=	1,585.05
Repairs	70	0	0=	340.66
Rent, 2,500 square yards	354	3	11=	1,723.69
Rates and taxes	220	0	0=	1,070.63
Insurance and gas	54	0	0=	262.79
Motive power, 102 indicated horsepower, at £3 10s.	357	0	0=	1,737.34
Labor, 50 weeks, at £31 9s. (1 overlooker, at £3 8s.; 5 teazers and fettlers, at 24s.; 4 girl card feeders, at 14s.; 4 girl carder minders, at 15s.; 1 spinner, at 50s.; 5 main piecers, at 25s.; 10 piecers, at 15s.)	1,572	10	0=	7,652.57
Miscellaneous expenses	50	0	0=	243.33
Total	3,619	13	9=	17,615.20

Production, 700,000 pounds per annum of 9-skein weft. Cost per pound, 0.138 pence (say, 0.15 pence, or 0.3 cent).

(6) TWISTING DEPARTMENT.

	£	s.	d.	
Capital expenditure:				
4 twisting frames, 160 spindles each	630	0	0=	$3,065.90
Pulleys and belting, etc	20	0	0=	97.33
Miscellaneous	5	0	0=	24.33
Total	655	0	0=	3,187.56
Departmental costing:				
Interest and depreciation (13 years) on £655, at 4½ per cent	64	0	0=	311.46
Repairs	5	0	0=	24.33
Rent, 172 square yards	24	7	4=	118.58
Rates and taxes	13	0	0=	63.26
Insurance and gas	4	0	0=	19.47

Departmental costing—Continued.	£	s.	d.	
Motive power, 9 indicated horsepower, at £1 15s	15	15	0=	$76.65
Labor, 50 weeks, at £6 14s. (6 girls, at 17s.; 1 man, at 32s.)	335	0	0=	1,630.27
Miscellaneous expenses	5	0	0=	24.33
Total	466	2	4=	2,268.35

Production, 243,750 pounds of 10-skein twist (with 12 turns twist per inch) per annum. Cost per pound of twisting, 0.46 pence (say, ½ pence, or 1 cent).

(7) WARPING AND BEAMING.

Capital expenditure:	£	s.	d.	
Four warping and beaming machines, at £55	220	0	0=	$1,070.63
Four cop reels, at £13	52	0	0=	253.06
Pulleys, belts, etc	12	0	0=	58.40
Miscellaneous expenses, fittings, etc	50	0	0=	243.32
Total	334	0	0=	1,625.41
Departmental costing:				
Interest and sinking fund (thirteen years) on £334	35	0	0=	170.33
Repairs	5	0	0=	24.33
Rent, 140 square yards, at 2s. 10d	19	16	8=	96.52
Rates, taxes, gas, insurance	13	12	6=	66.30
Motive power, 2 indicated horsepower, at £3 10s	7	0	0=	34.06
Wages, 5,000 cuts, at 1s. 4d. for 3 cuts (3 girls on piece-work)	111	2	0=	540.67
Miscellaneous expenses	10	0	0=	48.67
Total	201	11	2=	980.88

Production, 5,000 cuts per annum. Cost per 3 cuts, 2s. 5d. (58.6 cents). Cost per piece, say, 10d. (20 cents).

(8) WEAVING DEPARTMENT.

Capital expenditure:	£	s.	d.	
Forty looms, 10/4, 4-box, 80 pick, at £56	2,240	0	0=	$10,900.96
Heald straps, wires and streamers, at 20s	40	0	0=	194.66
200 persimmon wood shuttles, at 2s. 6d	25	0	0=	121.66
Forty pair 10-ringed temples, at 14s	28	0	0=	136.26
Forty wrought-iron pulleys, at 19s	38	0	0=	184.93
Forty belts, 300 pounds, at 2s	30	0	0=	146.00
Extra beams, pickers, etc	25	0	0=	121.66
900 healds and 120 slays	162	0	0=	788.37
Miscellaneous	150	0	0=	729.98
Total	2,738	0	0=	13,324.48
Departmental costing:				
Interest and sinking fund (ten years) on £2,738, at 4½ per cent	353	0	0=	1,717.87
Repairs, new healds and slays	90	0	0=	437.99
Rent, 720 square yards, at 2s. 10d. per square yard	102	0	0=	496.38
Rates, taxes, gas, insurance	138	0	0=	671.57
Motive power, 20 indicated horsepower, at £3 10s	70	0	0=	340.66
Weavers' wages, 40 men and women, 5,000 cuts, at 9s. per cut	2,225	0	0=	10,827.96
Other wages, fifty weeks, at £10 5s. (Two tuners, at 37/6; 1 chain-maker, at 16s., 2 putters-up, at 30s.; 2 twisters, at 18s.)	512	10	0=	2,494.08
Miscellaneous expenses	30	0	0=	146.00
Total	3,520	10	0=	17,132.59

Production per annum, 5,000 cuts of 65 yards (37-inch yards) each, 27 picks per inch. Cost per piece, 14s. 3d. ($3.462), approximately.

(9) PERCHING, KNOTTING, AND BURLING.

	£.	s.	d.	
Capital expenditure:				
Tables, benches, and perches, say	50	0	0 =	$243.33
Departmental costing:				
Interest and depreciation (twenty years) on £50, at 4½ per cent	3	16	10 =	18.69
Rent	20	0	0 =	97.33
Rates, gas, and insurance	20	0	0 =	97.33
Wages 1 percher, at 22s., 6 girl knotters and burlers, at 15s	280	0	0 =	1,362.62
Miscellaneous expenses	5	0	0	24.33
Total	328	16	10 =	1,600.30

Production, 5,000 pieces per annum. Cost per piece, 1s. 4d. (say, 32.3 cents) approximately.

(10) SCOURING AND FINISHING DEPARTMENT.

	£.	s.	d.	
Capital expenditure:				
Two washing and scouring machines	84	0	0 =	$408.79
Three milling machines	120	0	0 =	583.98
One hydro-extractor	120	0	0 =	583.98
One tentering and drying machine	427	0	0 =	2,078.00
One brush-dewing machine	45	0	0 =	218.99
One raising gig	41	6	0 =	201.96
Two sets teazle rods and 10,000 extra teazles	11	0	0 =	54.99
Three cutting-machines	99	0	0 =	481.78
One extra set 10 spiral cutters, 1 extra blade	9	8	0 =	45.74
One double brushing machine	48	0	0 =	233.59
One brushing and steaming machine	88	0	0 =	428.25
One rotary press	190	0	0 =	924.64
Fitting up, etc	20	0	0 =	97.33
One single-screw baling press	16	0	0 =	77.86
One 80-inch grinding machine	55	0	0 =	267.66
Pulleys, belting, tables	54	0	0 =	262.79
Miscellaneous expenses	100	0	0 =	486.65
Total	1,528	4	0 =	7,436.98
Departmental costing:				
Interest and depreciation (fourteen years) on £1,528 4s., at 4½ per cent	147	15	0 =	719.02
Repairs	28	0	0 =	136.26
Rent, 700 square yards, at 2s. 10d	99	3	4 =	482.59
Rates, taxes, gas, and insurance	93	13	0 =	455.74
Motive power, 48 indicated horsepower, at £3 10s	168	10	0 =	820.00
Steam for tentering, steaming, pressing, etc	85	0	0 =	413.65
Water for scouring, 2¾ million gallons, at 7d. per 1,000 gallons	80	4	2 =	390.33
Soap and other materials	50	0	0 =	243.33
Wages, fifty weeks, at £16 2s. (1 head finisher, at £3; 1 head scourer, at £2; 3 millers, at 22s.; 1 tenterer, at 22s.; 2 finishers, at 24s.; 2 pressers, at 25s.; 3 lads, at 12s)	805	0	0 =	3,917.53
Miscellaneous charges	20	0	0 =	97.33
Total	1,577	5	6 =	7,675.80

Production per annum, 5,000 pieces of 65 yards (37-inch yards) length each. Cost per piece, 6s. 4d. (say, $1.538).

(11) WAREHOUSE AND SELLING DEPARTMENT.

	£.	s.	d.	
Capital expenses:				
Table, scrays, etc	50	0	0 =	$243.33
Pattern-cutting machine	40	0	0 =	194.66
Miscellaneous	10	0	0 =	48.66
Total	100	0	0 =	486.65
Departmental costing:				
Interest and depreciation (twenty years) on £100, at 4.5 per cent	7	13	8 =	37.38
Rent, 50 square yards, at 2s. 10d	7	1	8 =	34.47
Rates, gas, and insurance	20	0	0 =	97.33
Wages, warehousman and lad, 50s. per week	125	0	0 =	608.31
Packing materials, etc	30	0	0 =	146.00
Selling cost, etc	400	0	0 =	1,946.60
Total	589	15	4 =	2,870.09

Production, 5,000 pieces per annum. Cost per piece, 2s. 5d. (58.6 cents) approximately.

(12) OFFICE AND FINANCIAL DEPARTMENT.

	£.	s.	d.	
Capital expenditure:				
Office fittings, carts, etc	300	0	0 =	$1,459.95
Departmental costing:				
Interest and depreciation (twenty years) on £300, at 4.5 per cent	23	1	0 =	112.17
Rent, 50 square yards, at 2s. 10d	7	1	8 =	34.47
Rates, gas, and insurance	10	0	0 =	48.67
Office materials, stamps	50	0	0 =	243.33
Clerks' wages	100	0	0 =	486.65
Manager's wages	250	0	0 =	1,216.63
Cartage	100	0	0 =	486.65
Bad debts	50	0	0 =	243.32
Difference between discounts received and allowed, 2½ per cent allowed on £2,500 (£625), less received, £255	370	0	0 =	1,800.61
Interest on capital for stock and wages—wages, £7,000 per annum; stock, £6,000—£13,000, at 4½ per cent for three months	146	5	0 =	711.71
Total	1,106	7	8 =	5.384.21

Production, 5,000 pieces per annum. Cost per piece, 4s. 6d. ($1.092).

(13) PATTERN MAKING AND DESIGNING DEPARTMENT.

	£	s.	d.	
Capital expenditure:				
Two power pattern looms and fittings	140	0	0=	$681.31
Departmental costing:				
Interest and depreciation (ten years) on £140, at 4½ per cent	17	13	0=	$85.89
Repairs	4	10	0=	21.91
Rent, 24 square yards, at 2s. 10d	3	8	0=	16.54
Rates, taxes, gas, insurance	5	0	0=	24.33
Motive power, one horsepower	3	10	0=	17 03
Miscellaneous expenses	2	0	0=	9.73
Weavers' wages, 2, at 27s. per week	135	0	0=	656.98
Material, yarns, etc	40	0	0=	194.66
Designers' wages	150	0	0=	729.98
Total	361	1	0	1,757.05

Production, 5,000 pieces. Cost per piece, 1s. 6d. (36.3 cents) approximate.

(14) DETAILED COSTINGS.

	£	s.	d.	
Mungo:				
100 pounds rags carbonized and dyed, at 3d.	1	5	0=	$6.08
1½ gallons oil, at 1s. 3d.		1	10=	.45
Pulling 84 pounds, at 0.1d.			8=	.17
Total	1	7	6=	6.70
84 pounds mungo, at 4d. per pound	1	8	0=	6.81
Blend:				
80 pounds mungo, at 4d. per pound	1	6	8=	6.48
10 pounds cotton, at 7½d.		6	3=	1.52
10 pounds cotton waste, at 4d.		3	4=	.81
1 gallon oil, at 1s. 3d. per gallon		1	3=	.30
Total	1	17	6=	9.11
90 pounds material at 5d.	1	17	6=	9.11

Yarn:

Carding and spinning 9 skeins yarn, at 0.15d. per skein, 1.35d. (2.70 cents).

Price per pound 9-skein yarn, 6.35d. (12.70 cents).

Carding and spinning 13 skein, at 0.15d. per pound, 1.95d. (3.90 cents).

Price per pound of 13 skein for twist, 6.95d. (13.90 cents).

Twist:	£	s.	d.	
42 pounds of 13 skein for twist, at 6.95d.	1	4	3=	5.90
6¾ pounds of 1/30s. cotton yarn, at 1s. 1d.		7	4=	1.78
Total	1	11	7=	7.68
48¾ pounds, at 7¾d. per pound	1	11	6=	7.66

Add for twisting ½d. per pound. Cost per pound twist, 8¼d. (17 cents).

COSTING OF PIECE.

	£	s.	d.	
48¾ pounds of twist, at 8¼d. per pound	1	13	6=	$8.146
55 pounds weft, at 6.35d. per pound	1	9	1=	7.073
Warping and beaming (see departmental costing)			10=	.200
Weaving (see departmental costing)		14	3=	3.462
Knotting and burling (see departmental costing)		1	4=	.323
Scouring and finishing (see departmental costing)		6	4=	1.538
Warehouse and selling expenses (see departmental costing)		2	5=	.586
Office and finance (see departmental costing)		4	6=	1.092
Pattern making (see departmental costing)		1	6=	.363
Total	4	13	9=	22.783
63½ yards (selling length), at 1s. 5¾d. (35.8 cents)	4	13	11=	22.845

Supposing that half of the weavers are men and half women, the foregoing complete mill requires 75 men and 43 women operatives, or a total of 118.

The total capital expenditure is seen to be £28,131 18s. The amount necessary for wages and stock in process per year is about £13,000, but figuring on a turnover every three months, that is three months' time on sales, the working capital needed is only one-fourth of this, or £3,250. This added to the capital expenditure makes £31,381 18s., so the capital stock needed to start the mill would be placed at about £32,000, or $155,000.

It may be noted that in the foregoing data the length of the piece or cut is given as 65 yards, each yard in these cases meaning 37 inches. The actual length of the finished piece is as stated, but it is one of the peculiar customs of the trade that in measuring the finished cloth for sale not only is 37 inches allowed to the yard, but there is a further allowance of one-fourth yard in 10 made to the buyer, so that the selling length on which the price per yard is based will only be given as 63½.

In regard to insurance, the regular rate for boiler insurance is 2s. 6d. per £100. On mill buildings and machinery the rate is compounded and varies greatly, according to the nature of the machinery and material, the oil used, appliances for extinguishing fire, etc. For example, a warehouse filled with woolen goods is rated at 7s. 6d. per £100 ($1.82 per $486.65); a teazing room is rated at 50s. ($11.17) per £100, but a liberal discount is allowed for a separate building and extinguishing appliances. If oils are used with a large percentage of unsaponifiable matter, that is with a high flash point, the rate of insurance is largely increased. When raw cotton is mixed with wool the rate of insurance is increased.

DYEHOUSE EQUIPMENT.

In the 40-loom mill for low tweeds figured on, the rags were bought already dyed, so no dyeing plant was necessary, but where dyeing is also performed at the mill the following data may be taken as typical:

	£	s.	d.	
Permanent investment (wool dyeing):				
Two vacuum wool-dyeing machines, at £95	190	0	0=	$924.64
Two iron reserve cylinders	44	0	0=	214.12
One indigo vat of wood 3 inches thick, 7 by 7 by 7 feet, with copper coil, steam taps, etc	33	0	0=	160.59
One hawking machine	35	0	0=	170.33
One piece-squeezing machine	20	0	0=	97.33
One wool-squeezing machine	37	0	0=	180.06
One small indigo mill, ½ cwt	18	0	0=	87.60
Total	377	0	0=	1,834.67
Permanent investment (piece dyeing):				
One piece-dyeing machine, with engine and winch	43	0	0=	209.26
One cleaning machine with engine and winch	43	0	0=	209.26
One cooler	18	0	0=	87.60
One washing-off machine	42	0	0=	204.39
Fixing and steam piping	50	0	0=	243.33
Pulleys and belting	7	0	0=	34.06
Miscellaneous expenses	20	0	0=	97.33
Total	223	0	0=	1,085.23
Total investment	600	0	0=	2,919.60

The above plant would dye 60 pieces per week and 3,000 pounds wool. Staff, 1 dyer, at £4 per week, and 5 laborers, at 24s. Total wages, £10.

Departmental costing:

	£	s.	d.	
Interest and depreciation (fourteen years) on £600, at 4½ per cent	58	13	1=	$285.53
Repairs	10	0	0=	48.67
Rent, 500 square yards, at 2s. 10d	70	16	8=	344.70
Rates and taxes	20	5	0=	98.54
Gas and insurance	4	0	0=	19.46
Motive power, 16 indicated horsepower, at £3 10s	56	0	0=	272.52
Steam	360	0	0=	1,751.94
Water	20	0	0=	97.33
Dyewares	200	0	0=	973.30
Wages, 50 weeks, at £10	500	0	0=	2,433.25
Miscellaneous expenses	30	0	0=	146.00
Total	1,329	14	9=	6,471.24

Of the above, the cost of wool dyeing will be about £600 and piece dyeing £729 14s. 9d. Therefore the cost per pound for dyeing wool is £600 divided by 3,000 × 50, or 0.96d. (say 1d., or 2 cents, a pound), and cost per piece of dyeing by piece dyeing is £729 14s. 9d. divided by 60 × 50, or 4s. 10d. (say 5s., or $1.22, per piece)

JUTE INDUSTRY OF SCOTLAND.

JUTE MANUFACTURE.

INDUSTRY HAS GROWN FROM SMALL BEGINNING TO GREAT PROPORTIONS.

Jute is the cheapest commercial fiber known and the latest among the main textile materials now in use—cotton, wool, silk, flax, hemp, and jute—to be subjected to modern methods of manufacture. Jute is grown almost exclusively in the province of Bengal, in India, and is manufactured at Calcutta, Dundee, Dunkirk, Hamburg, Vienna, Turin, Brooklyn, Ludlow, etc.

Jute was early cultivated in a small way by Bengalese, but was entirely unknown to the western world until 1824, when a small amount was shipped to the flax-manufacturing center of Dundee, on the east coast of Scotland, to see if anything could be made of it. Dundee was therefore the first town to manufacture jute, and at the present time this has grown to be its staple industry, and all other industries, such as shipbuilding, flax, hemp, and wool manufacture, whaling, etc., are of minor importance. The machinery for this industry is made in Scotland, and Calcutta as well as Continental and American mills are largely equipped with Scottish machinery.

When the first samples of jute were brought into Dundee it was found that the rough, brittle nature of the fiber made it difficult to work, and it was only used when mixed in small quantities with flax and tow. It was not until several years afterwards that adaptations were made in the softening and manufacturing processes that enabled it to be worked separately. The basis of the present extensive manufacture of jute at Dundee was laid at the time of the American civil war, which made cotton so high that there was a search for cheaper materials, and it was found that jute was adaptable for bags and many other articles for which cotton had theretofore been used. The Dundee manufacturers promptly took advantage of the opportunity thus presented, and the great fortunes then made enabled them to put the industry on a sound footing.

COMPETITION FROM INDIA AND THE CONTINENT.

Dundee for a while had as complete a monopoly of jute manufacturing as Bengal had and has of jute raising. Mills then began to spring up on the Continent, and recently Calcutta has begun to manufacture its home product, and on coarse goods, with its cheap labor working long hours, has had great success. Both Indian, Continental, and American mills have in the last two decades made great progress, and their number of spindles and looms are still increasing, while those of Dundee are barely holding their own. India now consumes nearly three times as much jute as Dundee, the Continent twice as much, and the American mills something over half as much. Dundee really represents the jute industry of Great Britain, for the few scat-

tered mills at Aberdeen and other points have a comparatively slight effect on the total output.

In 1905 there was much machinery standing idle in the Dundee jute mills, and it seemed as if the industry was destined to decline under the rapidly increasing competition of India, but there sprang up a strong demand for goods, and in 1906 the manufacturers had one of the most prosperous years since the civil war. The succeeding year was also prosperous, so much so that in 1906 and again in 1907 there were granted 5 per cent increases in wages. At present the industry is again in a depressed condition, and many mills are running short time, but it is not clear as yet whether this is to be of temporary or of long duration. While Dundee is not advancing like the other jute centers and is building no new mills, it nevertheless remains the leader in the manufacture of the higher grade articles, and its labor is more highly trained and skillful than that of any of its competitors. Hence Dundee can supply small orders of any width, weight, or length at any time, and can give delivery of large orders much quicker than either Calcutta or the Continent.

Dundee manufactures jute into quite a variety of products, including burlaps, sacking, bags, cotton-wrapper bagging, wadding, tarpaulin, sailcloth, floor cloth, curtain and furniture hangings, imitation tapestries, damask, table linen, and fancy goods, and also mixes it with tow, linen, cotton, and silk to produce various effects.

In the following notes will be shown where Dundee obtains its raw material and the extent of the crop available, what proportion of the crop is taken by Dundee, and where it ships the manufactured articles, together with a few figures as to the cost and methods of operation of the mills.

THE RAW MATERIAL.

Jute is a member of the mallow family and grows best in elevated, damp, hot climates. The commercial fiber is extracted from the stem of a plant that grows 3 to 12 feet high. This is pulled up by the roots or else cut down, and is retted in stagnant pools or running water and then the softened outside tissues in which the fiber is embedded are beaten or stripped off and the fiber washed, dried, sorted, and bundled. In sorting the woody and hard root ends, called "cuttings," are put in one bundle; the lowest class of fiber, called "rejections," is put in another, and the remaining material, graded according to length, size, color, etc., into the standard marks known to the trade. The bales weigh 400 pounds each. The finest variety of jute is Uttariya, which is stronger and finer, though not so soft as the next highest quality, which is called Deswald. Desi is principally used for making gunny bags and Deora for ropes. The qualities on which market quotations are usually based are "RF block-D," "First Marks," and "Daisee."

Many substitutes for jute have been tried, so far with not much success. The most promising seems to be the Madras Presidency, Hibiscus cannabinus, which is commonly called Bimlipatam jute or Bombay hemp, of which the small acreage is being increased. The latest competitor of jute products is paper, the paper yarns being used for the filling and jute yarns for the warp of bags. The paper, can not stand water, so it is a failure thus far, though German manufacturers are confident that this difficulty can be overcome.

INDIAN JUTE CROP.

In 1874 the jute crop reached only 1,750,000 bales; since which time it has increased by nearly 2,000,000 bales every decade, until the last season showed 9,800,000 bales of 400 pounds each. The government estimate for the coming 1908–9 season shows a great decrease in acreage, but with the increasing demand for jute and the increasing uses to which it is being put this decrease is probably only temporary. The following figures, from the Dundee Prices Current and Trade Report, show the Indian production, consumption, and export of jute for the past sixteen seasons:

Season.	Estimated—		Indian consumption.	Exported.	Total.
	Acreage.	Production.			
		Bales.	*Bales.*	*Bales.*	*Bales.*
1892–3	2,130,000	6,400,000	1,895,000	3,075,000	4,970,000
1893–4	2,223,000	5,450,000	1,780,000	2,525,000	4,305,000
1894–5	2,260,000	6,850,000	2,230,000	3,575,000	5,805,000
1895–6	2,240,000	7,125,000	2,390,000	3,500,000	5,890,000
1896–7	2,220,000	5,777,000	2,640,000	3,293,000	5,933,000
1897–8	2,170,000	6,800,000	2,700,000	4,206,000	6,906,000
1898–9	1,623,000	4,600,000	2,800,000	2,760,000	5,560,000
1899–1900	1,974,000	5,500,000	3,000,000	2,602,000	5,602,000
1900–1901	2,043,000	6,000,000	3,000,000	3,541,000	6,541,000
1901–2	2,249,000	6,500,000	3,100,000	4,328,000	7,428,000
1902–3	2,200,000	5,300,000	3,050,000	3,240,000	6,290,000
1903–4	2,100,000	6,500,000	3,400,000	3,787,550	7,187,000
1904–5	2,700,000	7,400,000	3,480,000	3,570,000	7,050,000
1905–6	3,160,000	8,400,000	4,050,000	4,170,000	8,220,000
1906–7	3,523,000	9,000,000	4,440,000	4,683,000	9,123,000
1907–8	3,883,000	9,800,000	4,350,000	5,400,000	9,750,000
1908–9	[a] 2,868,000	[a] 7,000,000	.....	.....	.....

[a] Indian government first estimate for 1908–9 season.

The government of India issues two estimates of the jute crop, one about July 15 and the other about September 15. As seen from the preceding table, their second estimates for the last few years have been remarkably close to the actual size of the crop as figured by adding the estimated mill consumption and the actual exports.

Formerly much of the jute used at Dundee went first to the London market and then by rail to Dundee, but the bulk is now shipped direct, and the small amounts that are imported by way of London or Liverpool are reshipped by water. The present freight rate from Calcutta to Dundee per ton of jute is 17s. 6d. (12d.=1 shilling=24.3 cents). The great bulk of the jute used on the Continent is now also shipped direct, so that London has lost most of its former importance as a jute trading center.

DESTINATION AND CONSUMPTION OF JUTE CROP.

In regard to the world's factory consumption of jute in 1907 the following is the estimate published by a New York house on January 1, 1908:

Countries.	Bales.	Countries.	Bales.
India	4,400,000	Italy	175,000
United Kingdom	1,300,000	Belgium	125,000
Germany	750,000	Spain	90,000
United States	600,000	Norway and Sweden	65,000
France	550,000	Holland	30,000
Austria	275,000		
Russia	185,000	Total	8,545,000

The latest Dundee estimate places both India and the United Kingdom at 100,000 less and the world's total at 8,275,000 bales.

Of the 4,400,000 bales used in India, the mills are considered to take 3,900,000 and the native consumption at 500,000. The Indian government figures for January 1, 1908, gave the jute looms in India as 29,074, of which 12,633 were sacking looms, over half of these being on 36 and 37 inch goods, and 16,441 Hessian looms, the bulk of these being on 46 to 53 inch goods. The rapid increase of the Indian industry is shown by the fact that on January 1, 1890, there were only 7,964 looms, of which the bulk were on coarse sacking.

The best estimate obtainable of the number of jute looms in Dundee is 9,000. There are no government or other accurate figures in regard to the size of the Dundee industry; an industrial census, the first of its kind in Great Britain, is now being taken by the Government in accordance with a law recently passed, and these figures will be published next year.

The import and export of jute and its manufactures for 1907, according to the government figures, were as follows:

JUTE MANUFACTURES—BRITISH IMPORTS AND EXPORTS.

	Import.		Export.	
	Quantity.	Value.	Quantity.	Value.
Jute ..... pounds..	814,990,000	$39,736,212	310,065,280	$15,989,212
Foreign-made yarn ..... pounds..	6,405,373	526,399	451,454	25,977
Other foreign manufactures	.....	13,428,294	.....	9,610,067
British-made yarn ..... pounds..	.....	.....	67,518,600	5,996,686
British-made piece goods ..... yards..	.....	.....	179,376,600	13,376,816
Other British manufactures	.....	.....	.....	621,982
Total	.....	53,690,905	.....	45,620,740

The foregoing embraces all yarns and manufactures of jute except that which may be embraced under "cordage, cables, rope, and twine of hemp and like material," of which it is impossible to ascertain how much is made of jute.

It is seen that the net import of jute for 1907, which may be taken as the amount used by the mills, was 504,924,720 pounds, of a net value of $23,747,000, which is 4.703 cents a pound. Of the British manufactures exported, the yarn averaged 8.88 cents a pound and the piece goods averaged 7.46 cents a yard. Other manufactures were listed by value only, but considering the total export of goods made from jute in Great Britain the value may be roughly approximated as 10 cents a pound, so that the value of the finished product of the jute industry is about equal to that of the raw material of the cotton industry.

Of the British-made yarn exported the best customer by far is Brazil, which now has five large establishments for the manufacture of the immense number of coffee bags needed for the yearly crop, and this manufacture is protected by a high duty. These mills as yet have only looms and buy their jute yarns from abroad, mainly from Dundee. The principal customers for the British-made jute yarns in 1907 were:

Countries.	Pounds.	Value.	Countries.	Pounds.	Value.
Brazil	35,005,300	$3,415,251	Netherlands	1,876,300	$144,107
Belgium	6,769,500	422,271	Spain	1,340,700	124,383
United States	4,082,200	372,409	Other foreign countries	4,695,800	340,655
Portugal	3,143,800	332,411	British possessions	2,717,100	236,638
Argentina	3,492,300	268,417			
Austria-Hungary	2,598,100	189,886	Total	67,518,600	5,996,686
Germany	1,797,500	150,258			

PIECE GOODS AND YARN.

Of the jute piece goods of British manufacture exported, by far the largest customer is the United States, followed by Argentina and Canada. The best markets for the British-made jute piece goods in 1907 were as follows:

Countries.	Yards.	Value.	Countries.	Yards.	Value.
United States	86,749,100	$6,623,661	Denmark	2,091,300	$199,658
Argentina	16,129,100	1,278,843	Chile	2,958,300	183,044
Canada	18,278,800	1,255,138	British East Indies	1,555,300	174,226
Australasia	8,935,400	730,140	Peru	2,079,200	131,395
Netherlands	5,448,600	392,673	Uruguay	1,298,200	121,959
Sweden	7,810,400	355,035	Russia	2,223,500	119,463
Turkey	3,548,100	281,863	All others	13,989,900	1,088,704
Germany	3,907,400	236,543			
Venezuela	2,374,000	204,471	Total	179,376,600	13,376,816

Of the $621,982 of other manufactured jute articles exported, Australasia took $106,509, the United States $105,647, and Denmark $78,867, the remainder being widely scattered. Of the jute reexported from the United Kingdom, the bulk is taken by France, Germany, and Belgium. Of the reexports of yarn, the largest portion is taken by Germany. Of the reexports of manufactures of jute, the largest amount, $4,658,773 in 1907, is taken by the United States. The great bulk of the manufactures of jute thus shipped to the United States through England comes from India.

The net imports of jute into the United Kingdom—that is, the imports less the reexports—for the past five years have been as follows:

	1903.	1904.	1905.	1906.	1907.
Pounds	357,295,680	455,094,080	507,752,000	517,296,640	504,924,720
Value	$10,155,806	$13,393,800	$18,551,048	$25,710,425	$23,747,000
Value per pound in cents	2.84	2.95	3.65	4.97	4.70

The value of net exports of jute yarn and manufactures of all kinds—that is, of the exports and reexports less the imports—for the past five years have been as follows:

	1903.	1904.	1905.	1906.	1907.
Yarn	$2,176,270	$2,009,276	$2,403,521	$3,675,590	$5,496,264
Other manufactures	8,768,912	8,552,105	8,835,389	9,943,053	10,180,572
Total	10,945,182	10,561,381	11,238,910	13,618,643	15,676,836

COST OF MILLS AND MANUFACTURING.

The present cost of erecting a jute spinning mill at Dundee is £9 ($43.80) per spindle, including buildings, machinery, equipment, etc., but not including land. Similarly the cost for a complete spinning and weaving mill for jute, exclusive of land, is £400 ($1,947) per loom.

The present Dundee prices for jute spinning machinery are as follows, reduced to American currency:

	Price.
Softener with 63 pairs of rollers	$1,606
Breaker card, 6 by 4 foot cylinder	1,144
Finisher card, 6 by 4 foot cylinder	1,216
First draw frames, 3 heads, at £60 per head	876
Second draw frames, 3 heads, at £60 per head	876
Roving frame, 10 by 5, 64 spindles, at 125s. per spindle	1,944
Spinning frame, 4-inch pitch, 4-inch traverse, 176 spindles, at 38s. per spindle	1,625
Twist frames, 128 spindles, at 60s. per spindle	1,866
Power reel, 90-inch swift	97
Cop-winding machine, 120 spindles, at 30s. per spindle	875

COST OF PRODUCTION AND OTHER PARTICULARS OF DUNDEE MILLS.

The cost of manufacture of various articles at Dundee can be accurately figured only when, in addition to the costs of material and the wages, one is furnished the general working expenses and standing charges as taken from the books of some mill, and even then, owing to the variety of articles being made, it is difficult to fix the ratio in which these pertain to the different goods. On medium-grade goods it is a custom of the trade to figure the other expenses as equal to the weaving expense in all cases where exact accuracy is not obligatory. Using this rule, and knowing the present price of yarns and the weavers' wages at Dundee, a good idea can be gained of the actual cost of manufacture. Figuring on the staple article of the Dundee manufacture—that is, the 11-porter, 40-inch Hessian, 10½ ounces per yard, 13 shots per inch finished—the warp used is 8½ pounds per "spyndle," which is 9 pounds per spyndle dressed. The length of warp is usually 108 yards and finished length 105 yards. The present price of 9 pounds per spyndle warp dressed is 2⅝d. a pound. For weft there is used 8½ pounds per spyndle yarn, and the present price is 1s. 6d. per spyndle. In figuring the total weight of weft 3 per cent is added for waste. The reed width is 43½ inches, which gives 258 splits or dents, with two ends to the split. Four cotton ends used for selvage on each side. We will figure that other expenses are equal to weaving expense. The price paid the weaver at Dundee for weaving these goods runs from 1s. 4d. to 1s. 6d. We will figure on the average rate of 1s. 5d. The expense of finishing and making up is $\frac{1}{12}$d. a yard.

The cost of manufacture of a cut of the above 40-inch, 10½-ounce burlap will therefore figure out as follows:

	Pence.
Warp, 34.92 pounds @ 2⅝d	91.67
Weft, 4.25 spyndles @ 1s. 7d	80.75
Weaving, 1s. 5d. per cut	17.00
Expenses	17.00
Finishing, 105 yards @ $\frac{1}{12}$d	8.75
Total cost per 105-yard cut	215.17

This amounts to 2.05d. or 4.1 cents per yard.

TERMS EXPLAINED.

The term "shots" as here used corresponds to the "picks" as used in the cotton-weaving trade and means the number of weft threads per inch of length. The term "porter" refers to the reed through which the warp passes and which regulates the number of warp threads to the inch of width. At Dundee this reed is reckoned by the number of porters of 20 splits (dents) in the Scottish ell of 37 inches. Thus the number of splits in an 11-porter reed 43½ inches wide is 11 by 20 by 43½ divided by 37, which gives 258 splits, and using 2 ends of warp to each split this gives 516 ends in the warp.

Jute yarn numbering is based on the spyndle of 14,400 yards. The weight in pounds of a spyndle is the number of the yarn. Thus if 14,400 yards weigh 9 pounds, this is called 9-pound yarn or simply No. 9. Cotton yarn is numbered according to the hanks of 840 yards each contained in 1 pound, so that the two numbering systems are inverse the one to the other, as one has a unit of weight for its base and the other an arbitrary unit of length. Thus No. 1 jute yarn is equal to No. 17.143 cotton yarn, No. 10 jute yarn is equal to No. 1.71 cotton yarn, No. 100 jute yarn is equal to No. 0.17 cotton yarn, and No. 400 jute yarn is equal to No. 0.043 cotton yarn. The cotton yarn is usually reeled in 54-inch hanks, while jute yarns are always reeled in 90-inch hanks. The yarn table for jute and dry-spun flax and tow yarns is as follows: Ninety inches, or the circumference of reel, 1 thread, 2½ yards; 120 threads, 1 cut or lea, 300 yards; 2 cuts, 1 heer, 600 yards; 6 heers, 1 hank, 3,600 yards; 4 hanks, 1 spyndle, 14,400 yards.

COMMERCIAL QUOTATIONS.

In buying and selling at Dundee jute is usually quoted per ton, medium and fine yarns per spindle, coarse yarns per pound, and rove per ton, cloth per yard, and bags per hundred. The following are the Dundee quotations on the staple articles quoted the 1st of January for the past thirteen years:

[£=$4.86; shilling=24⅓ cents; penny=2 cents.]

Year.	Jute.			8-pound cops.	Medium warps.	24-pound sacking weft.	10½-ounce 40-inch Hessians.	8-ounce 40-inch Hessians.	10-porter 74-inch floor cloth.
	RF block D.	First marks.	Daisee.						
	£ s.	£ s.	£ s.	s. d.	s. d.	d.	d.	d.	d.
1908	30 0	15 10	15 10	1 8	1 10½	2	2¾	2½	2¾
1907	37 0	26 10	25 0	2 11	3 0	2¾	3 5/16	2 13/16	3¼
1906	24 0	19 5	18 5	1 10½	2 0½	2 1/16	2 5/16	2¼	2¼
1905	18 15	16 0	14 5	1 6	1 7	1¾	1¾	1 13/16	2 1/32
1904	16 10	13 0	12 15	1 4½	1 5½	1 17/32	1 13/32	1¼	1 13/32
1903	16 10	13 10	13 0	1 4¾	1 6	1 9/16	1 13/32	1 9/16	1¼
1902	15 10	12 0	11 0	1 3	1 4½	1 7/16	1¼	1 5/32	1¼
1901	15 10	13 0	12 0	1 6¾	1 7½	1⅜	2	1½	2 1/32
1900	17 0	14 5	13 10	1 5¼	1 6¾	1⅜	2¼	1 15/16	2¼
1899	14 5	12 15	11 10	1 2½	1 3½	1 7/16	1 11/16	1 7/32	1 9/16
1898	13 0	10 5	8 0	1 2	1 3½	1 5/16	1 5/16	1⅛	1 13/32
1897	17 5	13 0	10 15	1 3½	1 5½	1¼	1¾	1 11/16	1¼
1896	13 0	11 0	10 0	1 2¾	1 4	1 5/16	1 11/16	1⅛	1¾

A DUNDEE JUTE MILL AND FACTORY.

The newer Dundee jute mills are well equipped and operated. The largest one that I went through contained 6,600 spindles and 700 looms.

This mill, as in fact nearly all the jute mills at Dundee, was in one story, with as few partitions as possible. The bag making was carried on in a three-story addition. The main part of the mill consisted of one room 800 feet long, with an average width of 80 feet. In this room were carried on all the operations from opening the bale to winding and reeling the finished yarn. The weaving and finishing processes were in separate rooms. In the main room the main shaft is 600 feet long and tapers from 8¼ inches down to 2 inches. It is at one side of the room and supported on bracket bearings and carries bevel gears that drive the countershafts at right angles, and the machines are belted from the countershafts. The main shaft runs 260 revolutions per minute and the counters 300 revolutions. Steel shafting and steel pulleys are used throughout, and grease is used in the shafting boxes, no oil being allowed, so as to prevent any dripping on floors or materials.

The posts are round iron, about 6 inches in diameter, and brackets on these carry all shafting. The roof is isosceles shaped from post to post, with one side glass covered. The floors are all concrete. The heating arrangement is by means of 4-inch steam pipes carrying superheated steam, and these pipes are run up the center of each alley, over the heads of the weavers, there being a U bend at each end. In the engine room four engines and Babcock & Wilcox boilers of Glasgow make are employed, with automatic stokers. The mangle machine is driven by a 50-horsepower motor, but the remainder of the mill by rope drive from the engines. Storage batteries are used to store energy to light and operate the machine shop at night when necessary. The mill itself does not run at night.

THE PREPARATORY AND CARDING PROCESS.

In the main mill the jute bales as they are brought in from the warehouse are first opened and graded and then batched by hand. For this purpose there are used large three-sided boxes on wheels, the boxes being about 4 by 6 feet and 6 feet high. The raw material is stacked in the box in layers and then oiled and watered with cans, each layer being so treated until the box is full. This is left to stand for forty-eight hours and is then started through the mill. The material is first run through the jute softener, which consists of a long series of spirally fluted rollers between which the material passes, while at the same time oil and water are fed onto it automatically along the flutes from cups at the side.

The softened material in shape to be worked then goes to the breaker card, where it is spread by hand onto the inclined endless feeding table at the back of the card and comes out at the front as sliver and coils into an elliptical-section can, these cans being about 36 inches high. Several of these cans are put to the finisher card and the material goes through and is then coiled into another can, shaped as before. Usually the breaker and finisher cards are placed in a row, one breaker to two finishers. The breaker card is fed from the back, but the finisher card is a complete circle carder, and the material is run in at the bottom in front and comes out at the top in front and falls into the can.

The finisher cans go to the first drawing, which is of the push-bar type, and has eight cans behind and two in front. Two slivers run together in passing through the rolls and faller pins and then each

two thus made are run together at the front, making a four-into-one doubling.

Eighteen cans are put behind the second draw frame, each sliver run through separately and then doubled, so that there are nine cans in front of each frame. Between the front and the calendar roll one sliver runs straight and the other passes through a slit in the front plate, which turns it at right angles and brings it up to double in with the first sliver. Cards and drawing both use cans of an elliptical section, and these are not revolved, as is customary in the cotton trade, with the round cans.

SPINNING AND WEAVING.

From the second drawing the cans go to the roving frame, and the bobbins made thereon then go to the spinning. The bobbins of rove are placed in the creel of the spinning frame and the ends brought down through the feed or retaining rollers, and then through tin roving conductors to the drawing rollers, some 8 inches farther down, which draft it out to the required size, the yarn then passing on through the thread-plate eye and winding onto the bobbin with the aid of the traveler. The top pair of rollers, called the drawing or retaining rollers, are of steel, the top one being corrugated and the bottom slightly scored to give it gripping power. The second set of rollers mentioned consist of a steel fluted roller, against which is pressed by means of weights a larger grooved wooden roller. The spindles are driven by tapes about 2 inches wide. The spindles used to make 8-pound warp in the mill in question were run at 3,300 revolutions per minute.

The filling goes to the cop-winding machine, where it is wound into 8-inch tubular cops for use in the shuttle, the tubular cops being preferred, as the filling pulls out from the inside. The warp bobbins go to the warp winder and are wound into cheeses, which are placed in the creel of a beam warper, and these beams then run through a sizing machine and onto loom beams, being then drawn in and sent to the looms.

The looms for jute are made very heavy, and those in use here are all of the overpick type. After weaving the cloth is run through a brushing and shearing machine called a "cropper," and is then measured and cut up into bags, and these sewn together with either the straight or the overlock stitch, and these then baled.

FINISHING PROCESSES AND WAGES.

This mill also makes "mangled Hessians." The "mangler" is a machine with two heavy rollers and between these is inserted a smaller roller around which is wound a roll of burlap. The two large rollers are revolved alternately backward and forward under heavy pressure, and this action gives a glazed finish to both sides of the roll of cloth from the outer to the innermost layer. Though no steam is used, the burlap is hot and smoking when taken from the machine. Three swinging rolls are used on which to wind the rolls of burlap so as to keep the machine in continuous operation, one roll being wound on and another being wound off while the third is being operated on.

At this mill the operatives in the preliminary stages of opening, softening, carding, and drawing are paid 18 to 21 shillings ($4.38 to

$5.11) for the men and 12s. 6d. to 15s. ($3.04 to $3.65) per week for the women. The roving and spinning frames are doffed or "shifted," as it is called here, by gangs of eight boys, who receive 11s. 5d. ($2.97) each per week. On the 144-spindle dry-spinning frames one girl runs one side, and at this mill is paid 13s. 6d. ($3.16) per week.

In the factory a loom fixer, here called "tenter," looks after 30 looms and is paid 11 shillings per week, and in addition a half-penny a shilling of the weavers' wages, so that he really makes 25 to 30 shillings per week. The wages of the weavers were varied according to the size of the loom and kind of goods being woven. On burlap 75½ inches wide, 8½ ounces per yard, 12-shot goods, using 8-pound warp and filling, and loom making 110 shots per minute, the weaver, running one loom, is paid 7s. 7½d. per 300-yard cut. On 50-inch 8-shot goods the weaver, running two looms, gets 2 shillings per 100-yard cut. On the standard 40-inch, 10½-ounce, 11-porter, 13½-shot per inch (13-shot per inch finished) goods the weaver, running two looms at 140 shots to the minute, is paid in this mill 1s. 4d. per 100-yard cut. It is the custom where a weaver is not capable of running more than one loom to pay her one-third more per cut than the weaver on the same goods running two looms.

JUTE WORKERS.

WAGES AND LIVING CONDITIONS OF THE MILL OPERATIVES.

In Dundee a girl running a side of 72 spindles on a jute dry spinning frame makes 10s. 6d. ($2.55) per week of fifty-five hours and pays 7 shillings ($1.70) a week for board and lodging. Those running two sides make 16 shillings ($3.89) a week.

In similar jute mills in Massachusetts for a week of fifty-five hours a girl running one side of 72 spindles makes $6 and for two sides makes $9, and pays about $2.75 a week for board.

The above figures are furnished by the president of a Dundee labor union, who lived in the United States for several years and is familiar with the conditions of the jute industry on both sides of the Atlantic. The weaving can not be so accurately contrasted for the reason that the United States makes practically only the coarser grades of jute articles, especially cotton-wrapper bagging, while Dundee runs mainly on burlaps, their staple article being the 40-inch, 10½-ounce, 11 porter, 13-shot Hessian, using 8½-pound warp and filling.

NUMBER OF OPERATIVES IN THE MILLS.

The latest accurate figures in regard to the number of operatives in the Dundee jute industry are those of the census of 1901. The total population of the city was then given as 161,173 (the present estimate is 165,000), and there was a much larger proportion of women than of men; of females above 10 years of age there were 72,723, as compared with 53,677 males above 10 years of age. Over half of the women in Dundee were engaged in earning a livelihood. The jute industry in particular has become known as a woman's industry, and nearly three-fourths of the workers are women. In 1901 there were 34,558 operatives engaged in manufacturing jute, hemp, and cocoa fiber, and their sex and age were given as follows:

Age.	Males.	Females.	Total.
12 and over	4,007	7,401	11,408
20 and over	3,871	13,719	17,590
45 and over	1,801	3,759	5,560
Total	9,679	24,879	34,558

In the smaller flax and linen manufacture there were 368 men to 1,305 women. The men have been forced out of the textile industries and can control the labor situation only in such industries as ship building, machine shops, house building, etc., and as there is not sufficient work for all many have to seek a livelihood elsewhere, and some join the ranks of the unemployed, and are partly or wholly supported by their wives.

WOMEN ACCEPT LOWER WAGES.

Up to the age of 18 the proportion of the sexes in Dundee is about normal, for many boys are employed in the mill as shifters, but as soon as they outgrow this work they lose their jobs, and having no opening in the only occupation for which they are trained they have to start as unskilled laborers elsewhere. On the other hand the fact that the jute industry is known as a woman's industry attracts girls from other towns for either a temporary or permanent stay. This excess of women workers is due to the fact that jute is the cheapest commercial fiber known, and the finished product manufactured therefrom at Dundee has to compete with the cheaper labor and longer hours of Hindoos working in the Calcutta mills, so that manufacturers are forced by economic conditions to get their labor as cheap as possible or else see the Scottish part of the industry drop out entirely. Even as it is, the Calcutta mills are increasing rapidly, while the Dundee mills are barely holding their own.

There are a large number of children employed in the Dundee jute industry, a good many being half-timers. The law requires children to attend school until 14, but they can be exempted at the age of 12 for half-time work in case of need. Where there is a family of four children and the income is under a pound ($4.86) a week the oldest child is allowed to be worked half time at the age of 12, and full time at the age of 13, irrespective of having attained any special standard in their school work. One member of the school committee said that the board as a whole were much opposed to child work, but that they considered it useless to attempt to fill a child's mind when its stomach was empty. More stringent restrictions, however, have lately been adopted and the number of half-timers is less than formerly.

HOURS OF LABOR AND SOCIAL DISTINCTIONS.

The legal hours of work are fifty-five per week, the mills running a ten-hour day, with five hours on Saturday. The usual hours are 6 a. m. to 9, 10 to 2, and 3 to 6 p. m., and on Saturdays from 6 to 9 and 10 to 12. This allows an hour for a 9-o'clock breakfast and an hour for a 2-o'clock dinner. Supper is usually eaten immediately on return from work, about 6.30 in the evening.

The operatives are paid weekly or fortnightly, usually on Thursdays or Fridays.

There is considerable diversity in the wages paid between different manufactories, and there is no uniform wage schedule among the manufacturers, all of whom are independent, rarely working together for any end except to avoid a general strike. The general average of wages is low, as might be expected in an industry that employs so many women, and that produces mainly cheap articles. As a rule the mill worker gets less than the factory worker. In Dundee all processes in manufacture up to making the finished yarn are carried on in a "mill," and processes after that in a "factory." These two sections of the business are not only separate departments of manufacturing, but they seem to have somewhat the effect of a social cleavage line, in some cases the operatives in the two sections refusing to associate with each other, even where they are both employed by the same company in the same building. The weaving and finishing processes, being lighter and cleaner work, attract the

better grade of women workers and they get better wages. Spinning in the jute business is an operation that requires a skilled worker, and for this a girl has to serve a long apprenticeship before she becomes expert, but she then gets less pay than a girl on the easier and simpler work of weaving, as one is in the "mill" and the other in the "factory." An explanation given is that when machinery was introduced the men hand-loom weavers refused to adopt power looms, and a class of women superior to those already engaged in spinning were tempted by higher wages to become weavers.

THE WEEKLY WAGES PAID.

The following table shows the weekly wages in the Dundee jute industry. In the first column is given the range of wages from the lowest to the highest, in shillings, while in the second column is given the predominant wage reduced to dollars. This predominant wage is not an average between the highest and the lowest, as that might be affected by exceptional cases, but is the wage that occurs most frequently on the pay rolls and is therefore the standard wage. [Shilling (s)=24⅓ cents; penny (d)=2 cents.]

Operatives.	Men and boys.		Women and girls.	
	Range of wages.	Predominant wages.	Range of wages.	Predominant wages.
MILL.	s. d. s. d.		s. d. s. d.	
Batching house	9 6 to 25 8	$3.89	9 0 to 22 2	$2.67
Preparers	7 0 to 22 0	2.43	5 11 to 16 2	2.14
Roving frame	8 0 to 15 0	2.67	9 6 to 14 0	2.55
Spinners			7 3 to 18 9	2.55
Shifters	7 0 to 12 6	2.43	6 11 to 12 6	2.31
Shifting mistresses			11 4 to 19 0	3.89
Rove carter	7 0 to 18 0	2.19		
Twisters			7 0 to 17 0	2.79
Reelers and winders			5 5 to 22 0	3.40
Half-timers	3 0 to 5 7	.87	3 0 to 4 6	.87
FACTORY.				
Beamers and dressers	9 0 to 32 6	4.86		
Drawing-in hands			9 0 to 20 0	2.43
Weavers	5 0 to 24 0	4.37	5 0 to 24 0	3.28
Tenters (loom fixers)	15 0 to 35 0	5.35		
Overseers	20 0 to 52 0	6.80		
Assistant overseers	10 0 to 24 0	4.25		
Croppers	14 0 to 26 0	4.86		
Calenderers	9 0 to 29 0	4.37	7 0 to 19 0	2.06
Sack machinists			6 0 to 29 6	3.40
Packers	16 0 to 26 0	4.13		
Oilers and weighers	10 0 to 24 8	3.89		
Sweepers	7 3 to 16 6	3.04	7 3 to 13 6	2.43
Laborers	7 0 to 26 0	3.89		
Dyers	8 0 to 34 0	4.86		
Foremen	20 0 to 30 0	6.32		
Machinists	18 0 to 31 0	7.29		
Joiners and woodturners	18 0 to 34 0	7.29		

DUTIES OF VARIOUS EMPLOYEES.

The term "preparer" includes all the operatives employed around the softeners, cards, and draw frames; the shifters or doffers are the boys or girls who take the full bobbins off the roving and spinning frames and replace them with empty ones—they usually work in gangs of eight; the croppers are the men who operate the brushing

and shearing machine. Nearly all wages are by the day, except reeling, winding, weaving, and sack sewing. The shifting mistresses who have charge of the gangs of shifters are usually paid by the day, with a premium on all production beyond a standard requirement. The tenters, who look after the looms, usually having 30 looms each to keep in order, are paid by the day and in addition get a premium of one-half to one penny (1 to 2 cents) for every shilling (24 cents) of the weaver's wages.

The women who sew the burlap into sacks, using either a straight or overlock sewing machine, are called sack machinists and are paid by piecework, but there is no uniform rate and the price varies also according to the size of sack to be sewed; some make good wages, at times up to 30 shillings ($6.30) per week. There is also a class of women, usually the very poorest, who sew sacks by hand at home, carrying a bundle of sacks weighing about 60 pounds from the factory to their homes, sewing them, and then carrying them back again. For some kinds of sacks the hand sewing is preferred to the machine work, but the remuneration is so small that a home worker who can make a shilling (24 cents) a day is doing very well.

In the factory there is no clearly defined line between the work of men and of women. Some of the heaviest work is done by women, but where the work requires both skill and strength men have to be employed. Women are not allowed by law to work overtime, but men can do so in those processes where women are not required.

HOUSING CONDITIONS.

The housing conditions of the Dundee operatives are on the whole not good; there is much overcrowding into rooms of small air space, and the sanitary arrangements are in many cases bad. The following figures from the census of 1901 show the housing conditions of Dundee as a whole at that time:

Conditions.	Number of families.	Percentage families.	Number of persons.	Percentage persons.
Living in:				
One room	7,371	19.7	18,252	11.3
Two rooms	19,503	52.2	83,367	51.8
Three rooms	6,177	16.5	32,463	20.1
Four or more rooms	4,352	11.6	27,091	16.8
Total	37,403	100.0	161,173	100.0

Dundee contains some very wealthy people living in magnificent villas, and also a large number of professional men, substantial merchants, and artisans who live in roomy dwellings, and if these be deducted from the foregoing total it is clear that the average operative lives in very crowded quarters. Two rooms is the usual allotment for the ordinary family of four to six persons, but in some cases there are four or more to the room.

The usual tenement-house rooms are small, measurements of 1,659 tenement-house rooms in 1905 giving an average size of 1,005 cubic feet. There should be at least 400 cubic feet of air space to each adult, and 200 cubic feet per child under 10, and the law requires this in regard to common lodging houses, but in most of the tenement

houses it was found that the actual air space was much less than this, and in some cases of overcrowding less than half what it should have been. The Dundee wage earning is comparatively low, and land is comparatively high. The area within the corporate limits for erecting workmen's dwellings is limited, and the yearly "feu-duty," or ground rent, runs from £80 to £160 ($389.92 to $774.64) an acre. A large proportion of the population must live near the factories, so they crowd into the nearest tenements. Most of the mills being in town, the operatives must live there.

The kitchen is generally used in Scotland for the sleeping room. This is all right in the cottages in the country, as it economizes fuel, and there is good ventilation. In the crowded tenements, poorly ventilated, this custom is very bad for the health, and it is especially bad for children. Dundee, with an infant mortality rate of 174 per 1,000 births, leads Scotland in this line, which is partly due to housing conditions. The tenants have a dread of drafts from open windows, so that there is little or no ventilation.

DWELLINGS AND THEIR SURROUNDINGS.

Most of the operatives live in three or four story tenements without attics. Only a very small portion live in detached buildings. In Scotland the census definition of a house is any dwelling with a distinct outside entrance from a street, court, or lane, or with a door opening directly into a common stair or passage. One, two, or more rooms inhabited by a family are therefore referred to as a house, whether it be a detached building or a suite of rooms in the heart of a big tenement.

The tenements of the better class have two houses opening on each floor on to a staircase lighted by windows, and they are supplied with modern sanitary conveniences, but in the older blocks the sanitary conveniences are far from satisfactory. In all the older tenements there is no water in the rooms, but a tap on the stairway or in the yard below supplies several families.

In some districts there is much old property and there are numerous "back lands"—that is, houses having no frontage on the street, but connected with it by a passage or narrow alley only, and inhabited by the very poorest classes. The blocks facing on the street are often of modern construction, having been built on the site of earlier buildings that have been demolished, while the back-land buildings inside are ancient structures in bad condition. The interior courts are used for ash pits, clothes lines, etc., and are often dirty and noisome. Usually the buildings on the street will be inhabited by well-to-do workers, while those behind are the abiding places of the very poorest classes. There has been much written about the bad housing conditions of late, and the modern tenements have larger rooms and are better arranged, but there are no model tenements as yet erected by either the town authorities or private parties.

Rents are paid weekly by the poorer and more transient classes, and usually semiannually by the others, monthly or quarterly payments being rare. A recent government investigation gives the following as the predominant range of weekly rents paid by the working classes living in Dundee tenements.

Rooms.	Predominant weekly rents, including rates.	Average weekly rent.
	s. d. s. d.	
One room	2 0 to 2 3	$0.52
Two rooms	3 0 to 4 9	.94
Three rooms	5 2 to 7 1	1.47
Four rooms	7 10 to 9 5	2.10

The rent is therefore about 50 cents a room a week.

FOOD SUPPLIES.

In regard to food, an investigation by the Dundee Social Union in 1905 showed that in families containing 2 to 7 people the daily expenditure per head for food was from 3d. (6 cents) up, the average for well-managed families, where the mother looked after the household at home, being not much over 5d. (10 cents), but this could only be effected by close economy. The higher paid workers, of course, spent much more. In cases where the mother worked in the mill the food cost was higher, and it is estimated that one-fourth of the 24,879 women employed in the Dundee jute industry are married. Where there were babies, and these were let out to old women to look after while the mother was at work, the additional expense amounted to about two-thirds of her wages. If she made 12s. ($2.92) a week she would have to pay 4s. (97 cents) for the care of the child and probably 3s. to 4s. (73 to 97 cents) more for food than if she looked after her home.

The family usually orders every Saturday night enough supplies to last them the coming week. The usual breakfast is porridge and milk, tea, bread, and butter. The father or mother will generally have an egg. Scotch broth soup is the staple dish for dinner, being made with one-half pound boiling beef, a pennyworth of leeks, carrots, and turnips, and a half-pennyworth of barley. The meat is eaten with potatoes as a second course. Poorer families will only have one-fourth of a pound of beef, with a pennyworth of bone or parings, and there is no second course. Pea and lentil soups are also used. Potatoes are largely used. Some families will have rice pudding for dinner also. Supper consists of bread, butter, jam or sirup, and where it can be afforded a little "kitchin" for the father, this latter being the term for a small fish, some ham, or other kind of meat. The children get pieces of bread and butter during the day when they ask for them. Where the mother is at work and the children at school there is little family life, and the meals simply become bread and butter meals, or meals of warmed over dishes, as the meal hours will be different and the family will only meet at supper.

Coffee is little used, tea being the general beverage. There is much "drinking" by the men, especially on Saturday nights and holidays, but efforts are being made to decrease this.

FOOD PRICES.

The largest food expenditure is for bread. "Scones" are baked by some of the women, but bread almost never, though it is usually figured that bread, cheap as it is, costs twice as much as its constituents. Most of the one and two room homes, however, have no

[illegible] bread baking. Bread is bought [illegible] potatoes, etc., is [illegible] pounds.

In the following table which shows the present [illegible] Dundee, the half stone at [illegible] reduced [illegible]

[illegible]	[illegible]	Pence
[illegible]	[illegible]	Pence
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

was much talk of a general strike, by laying the facts before the manufacturers he secured an advance of 5 per cent in the wages and prevented an interruption of business. This union has a reserve in the banks of nearly £10,000 ($48,665). Their weekly assessment is a penny (2 cents). The second and smaller society, the Dundee and District Union of Jute and Flax Workers, was organized in 1905 along the lines of affiliated union work, and has a membership of about 1,500.

The school system of Dundee is excellent, and schooling is compulsory up to 14 years of age, with the occasional exceptions in case of pupils of needy families. Everyone has to pay a school tax, levied by the school board. There are night schools, which charge a small fee. There is also an excellent technical school that teaches engineering and textile branches, especially those relating to Dundee's staple industry of jute manufacture.

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LACE INDUSTRY

IN

ENGLAND AND FRANCE

By

W. A. GRAHAM CLARK
Special Agent of the Department of Commerce and Labor

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DEPARTMENT OF COMMERCE AND LABOR,
OFFICE OF THE SECRETARY,
Washington, January 18, 1909.

SIR: I have the honor to transmit herewith, in accordance with the act making appropriations for the legislative, executive, and judicial expenses of the Government for the year ending June 30, 1909, approved May 22, 1908, a report by Special Agent W. A. Graham Clark, of this department, on the Lace Industry in England and France.

Respectfully, OSCAR S. STRAUS,
Secretary.

The SPEAKER OF THE HOUSE OF REPRESENTATIVES.

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LETTER OF SUBMITTAL.

NOTTINGHAM, ENGLAND, *August 14, 1908.*

SIR: I have the honor to submit herewith a brief sketch of some phases of the fancy-lace industry of Nottingham and Calais as found from my recent investigations at these points.

The Calais section, in France, and the Nottingham section, in England, supply the bulk of the fancy lace and net requirements of the world. St. Gall, in Switzerland, is the embroidery center of the world, as is Plauen, in Saxony, for embroidered lace, and Barmen, in the Rhine Province, for Barmen laces, but none of these products is lace in the correct sense of the word, the first two using the embroidery machine and the latter the braiding machine.

Over half of the American imports of cotton goods—$41,443,363 out of $79,524,943 in calendar year 1907—consisted of laces and embroideries. Of this great amount the United Kingdom supplied $7,256,131 and France $12,260,861, which were in both cases nearly entirely lace, as the embroideries were supplied by Switzerland and Germany. The import of lace alone, therefore, is fully twenty million dollars a year.

The French and English find their best lace markets in the United States. By calling attention to this fact and showing something of the conditions of manufacture in Europe, I trust that this report may assist in stimulating efforts that are now being made to initiate this industry in America and that the American manufacturer may finally gain as large or larger percentage of the fancy-lace trade as he has already of the smaller lace-curtain branch.

Very respectfully,

W. A. GRAHAM CLARK,
Special Agent.

To Hon. OSCAR S. STRAUS,
Secretary of Commerce and Labor.

LACE MAKING AT NOTTINGHAM

EXTENT OF INDUSTRY.

UNITED STATES TAKES NEARLY ONE-HALF THE OUTPUT—PRESENT METHODS OF MANUFACTURE.

Nottingham, in the Midlands, is the center of the lace and hosiery industries of Great Britain, though much of the lace finished and sold here is manufactured at smaller outside centers in England or in the border towns of Scotland. This is especially true of the curtain trade, of which Nottingham has only a small proportion of the total factories, but does most of the dyeing, starching, and finishing work.

The lace industry in and around Nottingham is divided into three branches—the Levers fancy lace, the plain net, and the lace-curtain branches—each with a standard wage schedule of its own. The fancy-lace branch of the trade is by far the largest, followed by the plain net, and then the curtain.

The leading manufacturers estimate the total output of lace of all kinds from Nottingham at 4,000,000 to 5,000,000 pounds, worth about $20,000,000 to $25,000,000 annually. The government statistics showing that Great Britain exports this much annually would tend to indicate that much lace is made in the scattered sections outside of this center.

EXTENSIVE AMERICAN PURCHASES.

The cotton and silk lace and net and articles made thereof exported by Great Britain in 1907 amounted to $35,474,206, and of this amount $15,396,911 worth was sent to the United States alone. Over a third of the total lace exported by Great Britain was imported and then reexported, and over half the lace bought by the United States from Great Britain every year is of Continental origin. This is shown by British official figures covering exports for 1907, as follows:

Description.	To all countries.	To United States.
British made cotton lace and patent net	$23,709,048	$6,837,725
British made silk lace and articles thereof	670,589	132,826
Foreign made cotton lace and articles thereof	8,924,241	6,483,502
Foreign made silk lace and articles thereof	2,170,328	1,942,858
Total	35,474,206	15,396,911

Great Britain imported in 1907, $17,207,622 worth of cotton laces and $1,361,242 worth of silk laces.

It is seen that the United States is Great Britain's most important market for lace and its manufactures, for of British made lace exported the United States absorbed nearly 30 per cent and of the foreign made lace reexported it took over 75 per cent. Of the British made laces the bulk is shipped from Nottingham. For the fiscal year ending June 30, 1908, the American consulate at Nottingham records the lace shipments of all kinds to the United States as amounting to $5,423,902, against $6,258,758 for the preceding fiscal year.

Next to the United States the best customers for British made laces are Germany, New Zealand, Australia, France, Belgium, Brazil, Argentina, and Mexico.

While the lace trade of Nottingham is prosperous, it does not seem to be advancing as fast as the Calais section in the manufacture of fancy laces, though it still holds its own in other lines. These are the two main lace-making centers of the world. Though Switzerland leads in embroideries, and Germany in etched laces and Barmen laces, none of these articles are really lace, as they are not made on lace machines but on embroidery and braiding machines. The methods and machinery used in the English and French lace making are almost identical and each has borrowed part of the trade vocabulary of the other.

WORKING PERIODS AND FACTORY BUILDINGS.

At the present time (October, 1908) the lace trade is in a depressed condition due to the financial condition of the world, and factories at Nottingham and on the Continent are running short time, and some have even stopped, but this depression can not reasonably last much longer. Ordinarily the factories run night and day, that is up to midnight. Two lace makers, twist hands as they are usually called, are employed alternately on each machine and they divide the weekly wage made between them. One shift works from 4 to 9 a. m. and from 2 to 7 p. m. and the other from 9 to 2 and from 7 to 12. Each alternate week the shifts are changed, so that the one that begins at 4 o'clock one week begins at 9 o'clock the next. On Saturdays the mill stops at 2 o'clock. In some factories the shifts, instead of working five-hour periods, work alternately four and six hour periods, and the factories stop at 1 o'clock on Saturday.

The lace factories of Nottingham are usually three or four stories high, and must be built very strongly to sustain the weight of the heavy machines, as ordinary lace machines weigh about 12 tons each and are closely spaced. The factories are usually in rectangular form, but some that have grown up gradually are in all shapes with additions here and there. The new factories are up-to-date, though the old factories are not very economically or conveniently arranged. The rooms are usually well lighted, are 12 to 14 feet high, and of a width to set in one machine endwise with an alleyway down the side.

There are a good many small machine users and to accommodate these outside capitalists have erected large factory buildings and equipped them with power and light. In such cases there are a good many machine owners in one building or even in one room. They

usually pay according to the "standing" required for one machine, the ordinary 32 by 7 foot standing rent being from 5s. 6d. to 7s. ($1.34 to $1.70) a week. Besides the machine owners, such factory buildings usually contain other men who make a specialty of preparing the yarn in the forms required for the machines.

MACHINE VARIATIONS AND IMPROVEMENTS.

In addition to the three main types of Levers fancy, plain net, and curtain machines, there are in the Nottingham district variations of these such as the warp-lace machine for making edgings, purlings, etc.

At Calais the fancy-lace machine is practically the only one used as the net or "tulle" is made mainly at Caudry and Lille. The French curtain trade is comparatively small.

At Nottingham also the fancy-lace machine is by far the most important, though there is a very large number of net machines employed. The curtains are mainly made elsewhere and finished here. At Nottingham the factories now tend to leave the town, as they can get cheaper labor with less restrictions outside. Thus places like Long Eaton, 7 miles away, which have the newer factories with newer machines and cheaper labor, can frequently do work cheaper and better than Nottingham itself. In the same way, in France, Caudry tends to take away much of the trade of Calais.

The present fancy-lace machine is due to the French. Though the bobbin net lace machine itself was invented in England and smuggled over to France, it was not until 1834 when the Jacquard was invented and adapted to the use of this machine in France that the modern fancy lace making by machinery really came into existence. Since then it has been a race between the English and the French inventors as to which could make the most new inventions and adaptations to originate new methods and laces. The French seemed to be in the lead till recently when the English again went ahead by inventing minor improvements and embodying them in a machine 260 inches long, whereas the largest in the world heretofore has been 230 inches.

DISSEMINATION OF METHODS—FANCY-LACE MACHINES.

The English are refusing orders from abroad for some of their new improvements, as does one of the largest French manufacturers who refuses to sell any of his machines to the United States. Such methods can not be successful in the long run. Less than 100 years ago the English made heroic efforts to prevent other nations from using their machines, and in the case of lace machines any exporter was punished with heavy fines and other penalties, even transportation to the colonies. These methods were of no avail, for the French industry was started with English machines and English workmen smuggled across the Channel in spite of all edicts.

There is not much demand ordinarily for very wide machines. The regular widths are 172, 184, and 222 inches. In 1907 of 206 "go-through" machines sold by John Jardine of Nottingham (the largest lace-machine manufacturer in the world) 90 were 172 inches wide on the metal, 73 were 184 inches, and 43 were 222 inches wide. The fancy-lace machines employed run from 8 to 18 point, which means 16 to 36 bobbins to the inch of width. The cost of fancy-lace machines vary, according to the width and gage, from $3,000 to $5,000 each.

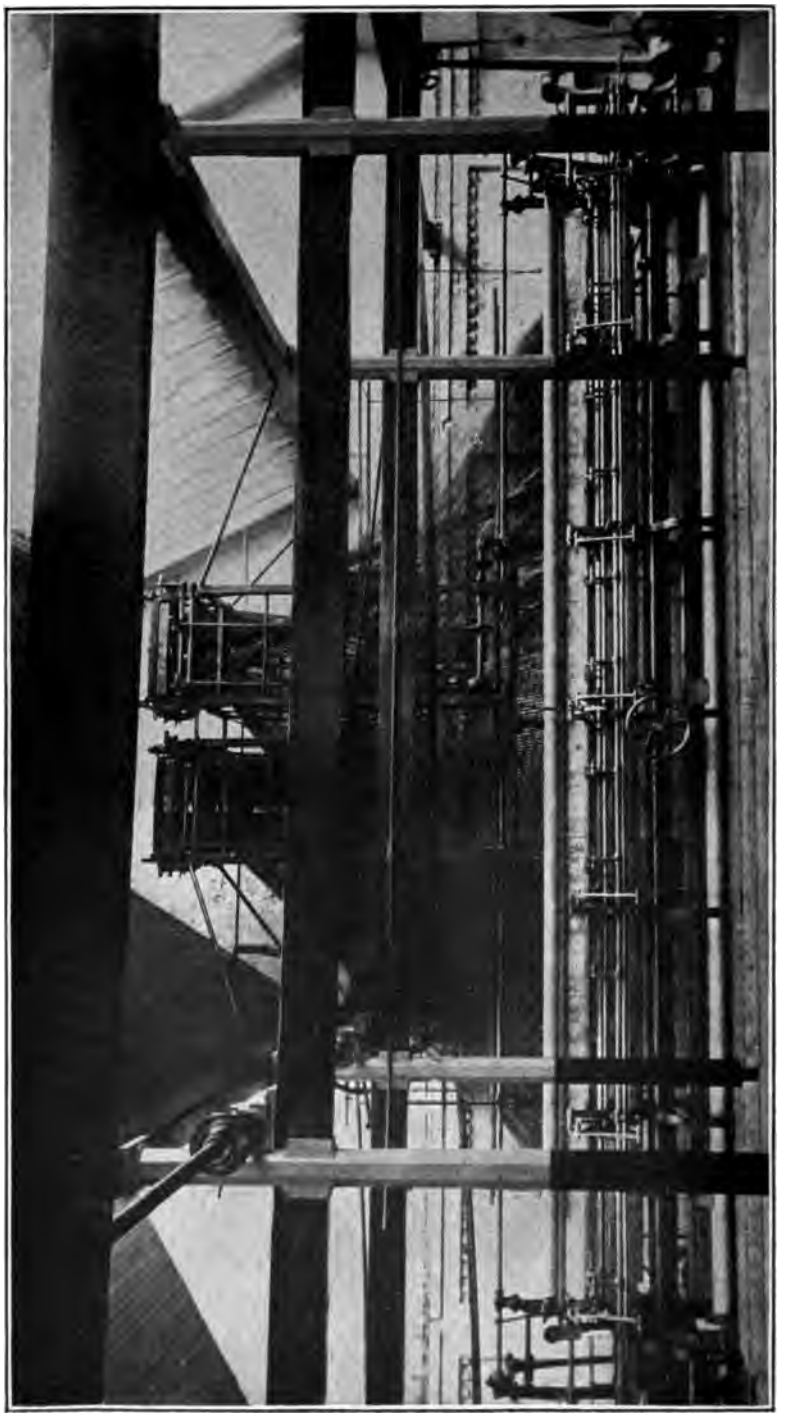

FIG. 1.—372-inch lace curtain machine as made by Swift & Wass for Swiss and combination curtains.

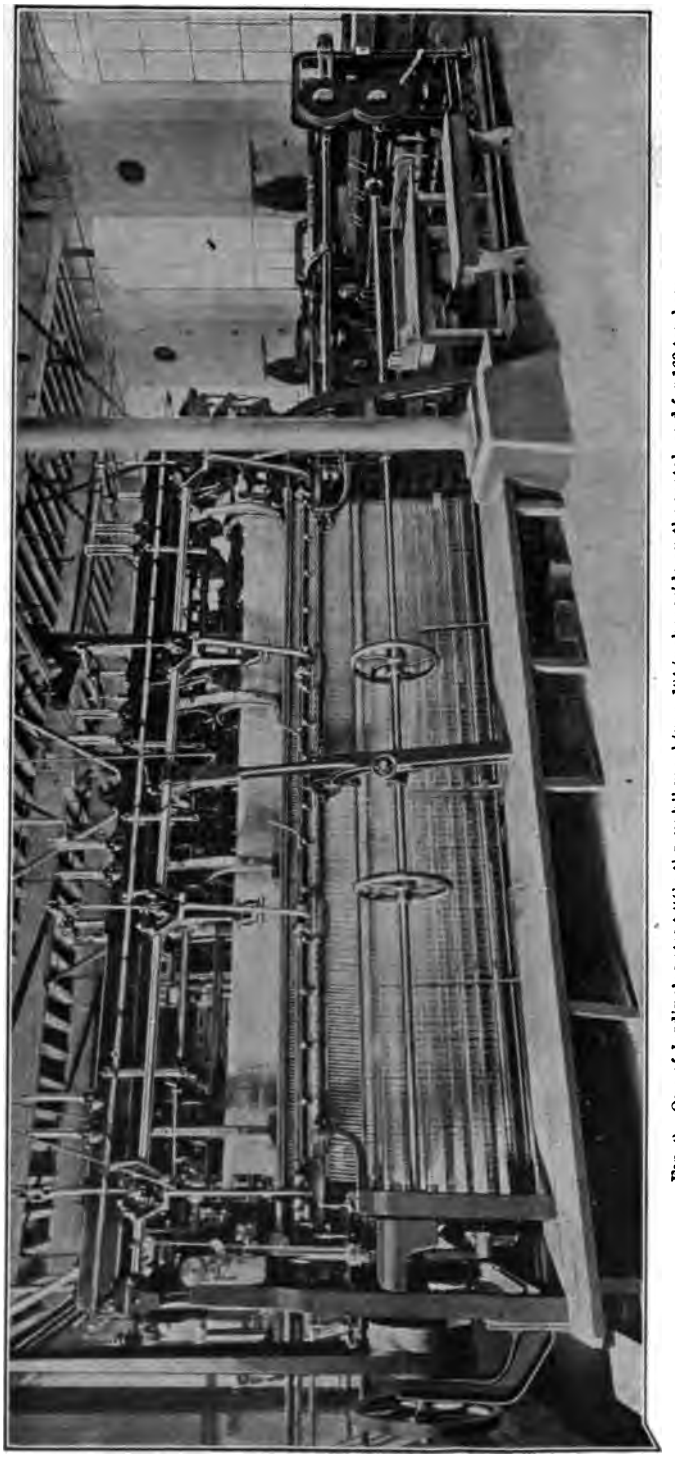

FIG. 2.—One of Jardine's patent "Go-through" machines, 184 inches wide on the metal, and for 160 top bars.

There are two general types of the fancy-lace machine, the "Levers with lean bars" and the "Levers go-through." In the first the thin steel chariots that carry the bobbin, in swinging back and forth across the "well" (the central space left for the vertical warp threads) from one set of combs to the other land on brass sliding bars, while in the "go-through" they slide into the combs without any brass bars. The trade defines a "go-through" lace machine as one which carries the bobbin threads twice through the warp at one revolution of the crank, and works without "landing bars." This permits of higher speed and as it gives more production it is the one now most largely employed.

SPEED OF MACHINE—PREPARING THE YARN.

Its method of operation, however, puts more strain on the yarn, due to the quicker motion, allowing less "dwell" of the chariots at the end of their course, which makes more of a jerk at every reverse of the direction. The Levers with lean bars has therefore had to be employed for the finer work, but Jardine has recently modified the motion of the chariots by means of elliptical gearing so that the speed is much less at the ends than in the center of the swing. As this allows of any desired dwell, it tends to make this type of machine suitable for much work, for which heretofore the slower, old style machine only was adapted. Jardine's elliptical gearing arrangement for "Go-through" machines is shown in Fig. 3.

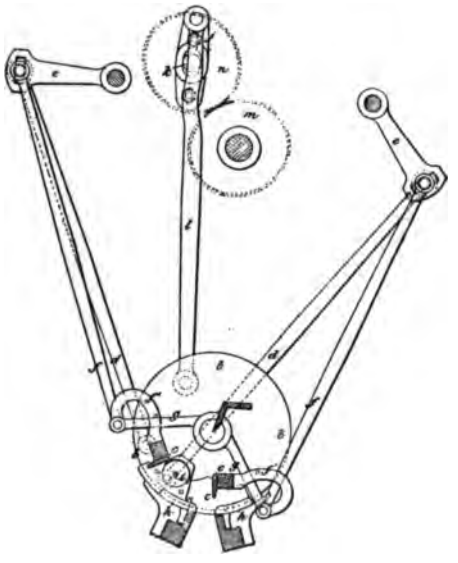

FIG. 3.—Jardine's elliptical gearing arrangement for "Go-through." machines.

Fancy-lace machines are run at a speed of 110 to 120 picks per minute. The production varies according to the size of the rack, but will average something like a yard an hour. The number of inches produced per rack of 1,920 motions is called the "quality" at Nottingham, and is the same as the term "rendement" used by the French. The Levers lace machine is described in my Calais report, and as the same type of machine is used at Nottingham it is needless to reproduce it here.

The methods of preparing the yarn, which is bought on either the cop or the hank, is also the same. As in France the thin steel bobbins after being taken from the frame have the small portions of thread remaining wound off, and are then again filled with thread on a bobbin-winding machine, where 120 are filled at one time. Before replacing in the machine the bobbins are heated and dropped over a central bolt, and a top weight screwed down until they have been

pressed out perfectly flat. Bobbins are usually made of hard, rolled brass in two pieces. A recess in the metal on one side of each piece allows space enough to hold the thread after they have been riveted together. Usually about thirty minute rivets are used in each bobbin. A bobbin for 11-point lace is so thin when completed that it is only one forty-eighth of an inch in thickness, with the yarn inside.

The lace machines at Nottingham have their width stated in quarter-yards and this basis is used in the wage schedules. The average wages earned by lace makers on Levers fancy-lace machines at Nottingham are from 45 to 55 shillings ($10.95 to $13.38) and on plain net machines 32 to 44 shillings ($7.78 to $10.70) a week; specially skillful workers are paid more.

BAND CIRCULAR MACHINE.

While in the fancy lace line Calais makes more than Nottingham and has a greater reputation for artistic work, in making net the English are ahead, at least in quantity. Plain net is a very important branch of the lace industry at Nottingham, and there is a large export trade, especially to Switzerland, which uses tons of English-made net every year as a foundation material for its embroideries. The Jacquard is not usually employed on net machines. The "band circular machine" takes up less space and looks simpler than the Levers machine, but it is really more complicated, as far as the main machine goes, and costs more to build. The prices run from $3,000 to $7,000, according to width and gage. The usual gages are 5 to 14. These machines are known as "double locker" or "rolling locker" plain net machines, according to the method of driving the bobbins. The French call them "1 jeu" (one play) or "2 jeu" according to whether one or two rows of bobbins are employed. In the first case if the machine is 300 inches long and there are 16 bobbins side by side there will be 4,800 bobbins in all, and in the latter case 9,600 bobbins. Where two rows of bobbins are used each pair swings back and forth in the same line, and as this arrangement gets in more threads in the same width it permits of finer work and can also be used with special appliances for ornamentation.

In a fancy-lace machine the two rows of combs or grooved bars in which the chariots slide are stationary. In a band circular machine they are movable and placed back and front of the warp threads so as to be in the circumference of a circle, hence the name "band circular machine." When the bobbins have moved through the warp, the comb bar, which receives them on the other side, has a lateral motion given it equal to the space between two threads. If, then, the bobbins be brought back on the contrary side of each vertical warp thread, each bobbin thread will have made one twist with a warp thread. If now the front comb bar be moved laterally till each bobbin stands opposite the space from which it first started and the bobbins be again passed through and brought again to the front on the other side of each vertical warp thread, the threads will have been twice twisted. The machines are made so that each bobbin, as it gradually moves up from one end of the machine to the other and back, can be made to twist one, two, three, or more times

around each of the warp threads met within its course, but usually a particular machine will not have more than one variation; that is, it can be set to twist two or four times or another one can be set to

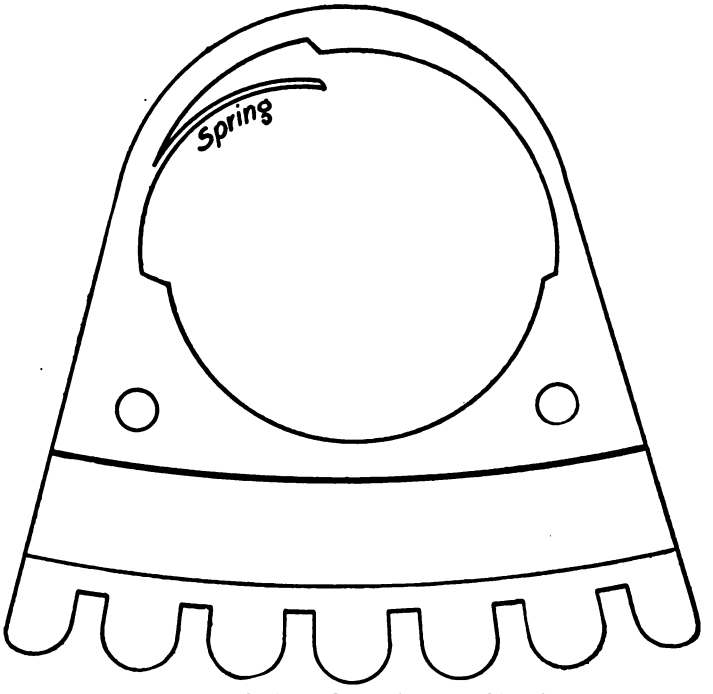

FIG. 4.—Bobbin chariot used on plain net machine; full size.

twist three or five times, etc. A good band circular machine will make more than 30,000 meshes a minute. In the case of the band

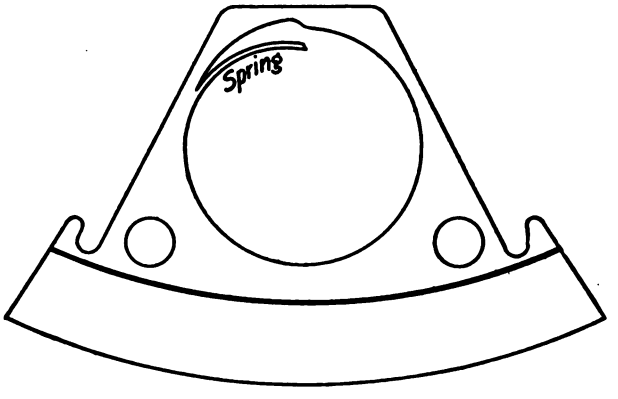

FIG. 5.—Bobbin chariot used on Levers fancy lace machines.

circular machine the push bars can not be used to move the chariots, as in the Levers machine. [illegible] yen positively by means of long gears or pinions, whi[illegible] of the machine to the

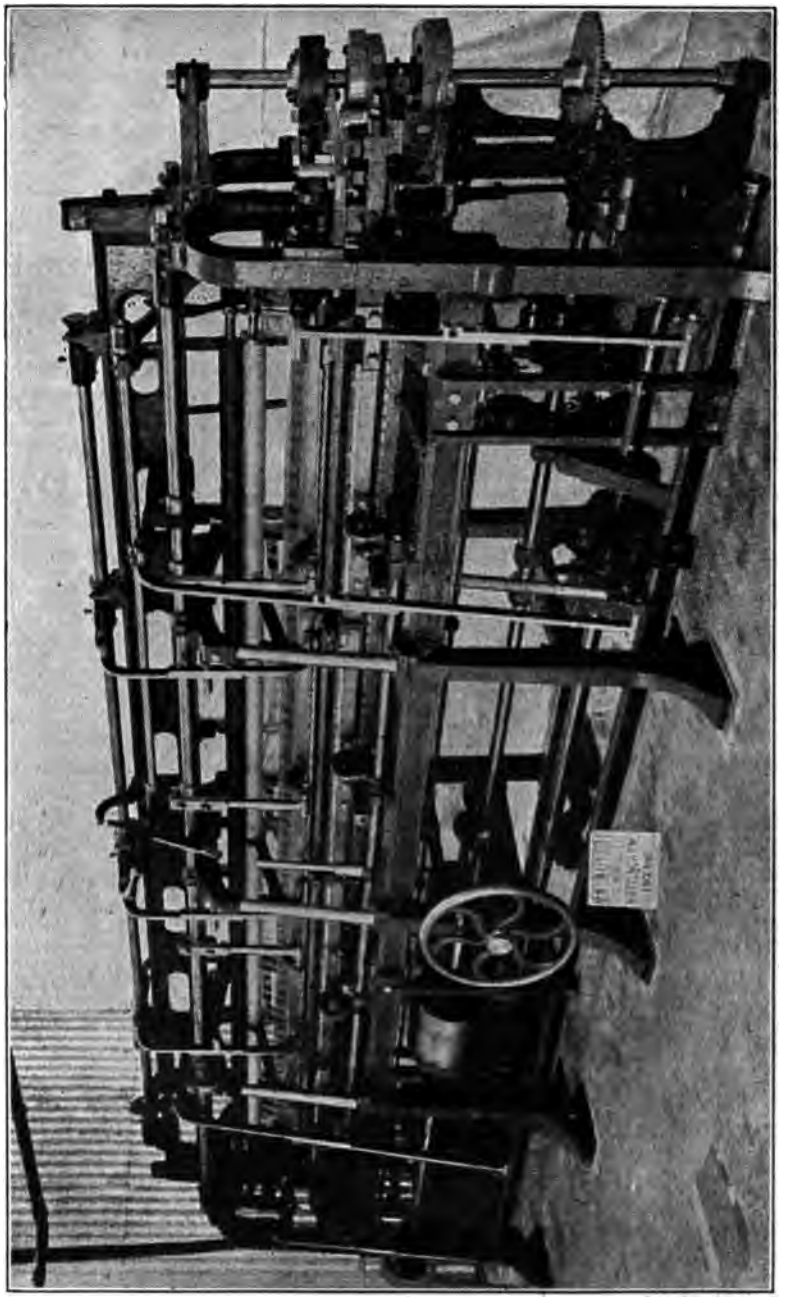

FIG. 6.—Double locker plain net machine.

other, and which gear with teeth cut in the bottom arc of each chariot. The quality of net depends on the smallness of the meshes, their equality in size, and the regularity of the hexagons.

In square tulle the machine is made usually with stationary combs and only one set of bobbins. There are two long beams under the machine, the one carrying the warp threads tightly stretched and the other the filling threads loosely wound. The thread from the bobbin follows the warp threads and wraps around it and the filling where they join together.

CURTAIN-MACHINE OPERATIONS.

The lace-curtain machine is the widest lace machine made, as the usual width is from 200 up to 440 inches. Ply yarns are nearly always employed and the gage is much coarser than ordinarily employed on other lace machines. In this, as in other cases, the finer the design and the higher the counts of yarn the narrower is the machine required. "Point" on a curtain machine means double the coarseness of the term as employed for Levers machines; that is, 10-point Levers lace is made with 20 bobbins to the inch, while 10-point curtain lace is made with only 10 bobbins to the inch of width. The curtain gages used run from as coarse as 5 up to about 18, and the fine gages used on Levers machines are not found on curtain work. The prices of curtain machines vary according to the width and gage from $2,500 to $3,500. The curtains at Nottingham are made in any width from 30 to 75 inches or wider. A usual width is 60 inches, and machines are ordinarily made a multiple of this in width, with an allowance for side space. On fancy lace machines the Jacquards are at the sides as the outline and guimp threads, as well as the regular warp threads, are on beams under the machine; curtain-lace machines draw the ornamenting threads from a horizontal creel of spools at the back of the machine, and so put the Jacquards overhead. Fancy-lace machines employ bobbin threads and three kinds of beam threads. The lace-curtain machine employs bobbin, warp, spool, and extra beam threads.

Fancy lace is usually made in a series of narrow strips, curtains are made in a series of wider breadths, and net is usually made in one piece the full width of the machine.

WORKING OUT DESIGNS.

It may be noted that the designs for the Jacquard cards are punched differently for fancy lace and for curtain lace work. In the first case the design is small and quickly read and the cards are punched direct on the piano punching machine. For curtains the designs are so much larger that the cards are punched by the tying-up and selector machine method. This system is as follows:

The design is drawn on white relief on a black background, then transferred and painted in colors on cross-section paper. This sheet is fixed on a vertical board to be "read." The reader's object is to make arrangements for punching a series of Jacquard cards in the order required. Hanging from the frame in front of the reader are a number of strings, of the nature of whipcord, and transversely to these, at one side of the frame, are other similar cords. The lines in the pattern represent lines in the curtain, and for every one there is a

cord. The reader so arranges the cords that when attached to the selector they will each exercise a controlling effect in producing one motion at the correct place in the pattern. The reader rapidly and deftly works with his fingers among the cords, separating some and taking up others, and getting them in groups, at the same time forming a kind of interlacement with the transverse cords, so as to show in a rough but correct way something of the pattern before him. As the reader is paid per 100,000 squares of the pattern read, he has to be a skillful worker. A good reader will earn £2 10s. ($12.17) a week.

When the reading is finished, these carefully grouped cards are laid on a long horizontal frame called a "selector," to which, at one end, is attached a punching frame. According to the order in which the groups of cords fall, each cord acts upon punches to which they are connected and in such way as to perforate the required number of holes in one card. As each group is in its order taken up by a treadle movement they are made to act upon the punches, and simultaneously with each perforation movement a card drops into the receptacle placed beneath. These cards follow each other in sequence of design and are strung together to form the pattern, there frequently being 1,500 or more in a design. The cards are laced together either by hand or automatically, many of the Nottingham manufacturers preferring the slower and more primitive hand system as being better and more reliable.

Whether fancy lace, net, or curtains, the manufacturer's work ceases with "making," and he usually sells in the gray. They then go to the finishing factories. Even where manufacturers own finishing plants, which is not usual, the finishing plant is always entirely separate and in another part of the town, usually in the suburbs and under a different manager.

DRESSING AND FINISHING FACTORIES.

Nottingham is noted for its lace-dressing establishments, and much lace that is made elsewhere is brought here to be finished, making this town the great central point for the lace trade of the country.

The bleaching and finishing of lace, being a special branch of the trade, is nearly always carried out by a separate establishment and usually by firms who do nothing esle. At Nottingham there are 27 of these lace and net dressing firms that employ altogether, according to 1907 figures, some 1,638 operatives, of which only 221 are men (foremen and laborers mainly), 1,002 adult females, 408 young persons (nearly all girls) and 7 children. The women are paid by the hour, 2¾d. to 3d. an hour, which is about 12s. 10d. to 14s. ($3.12 to $3.30) for a fifty-six-hour week, and the forewomen in the drying rooms £1 10s. ($7.29) a week, while the male laborers average about £1 ($4.87) a week.

The great bulk of the operatives in these dressing factories are women, and some firms—at least three or four of the largest—have morning services in a chapel connected with the mill from 8 to 8.30, which is attended by all operatives and the time is counted in the pay roll.

Lace or net is a delicate fabric and has to be handled carefully in the finishing processes. After "making" on the machine it is carted

to the finishing plant. Nearly all of this is in the gray state, as very little is made of bleached yarn. Here it is first carried to the "dipping room" and washed, then bleached with alkaline dyes, again washed, and the superfluous water removed in a hydro-extractor. Some of the coarser grades are put through the stocks, usually curtain work. These, while similar to the familiar stocks employed in woolen cloth felting, are of gentler action, the lace being put in masses in a big tub, and vertical wooden blocks fastened to horizontal cranks are used to stamp on it until beaten clean. After bleaching and washing, and in some cases dyeing, the material is starched, gelatin being used for silk and rice starch ordinarily for cotton materials, the superfluous material squeezed out by running between wooden rollers and the material then carried in a wet condition to the dressing room to be dried.

DRYING MACHINE—NET-LACE DRESSING.

In the case of curtains and similar coarse materials the drying is done by means of the ordinary tentering machine. This machine consists of two rows of chain tenterhooks, to which the material is attached, and these pass as an endless chain through an inclosed drying box heated by multitubular boilers, the air being driven through the steam-heated boiler tubes and the lace coming out and winding up on a roller at the other end.

The dressing frames as used for net, etc., consist of a pair of movable rails placed about 3 feet above the floor and arranged so that they can be separated from each other to any required distance. Each rail carries a row of pins on which the material is fastened and then a winch is used to draw them apart to the original width of the lace as it was made in the machine. Some rails are arranged so that they can be swung back and forth in opposite directions so as to open out the meshes to their correct shape before leaving to dry. This same method is used at Tarare, in France, and other similar places for squaring the threads in fine muslins before drying.

The roll of lace as dried on these Nottingham frames is frequently 300 inches or more in width and is brought to the machine by a gang of girls who hold it up and unroll it as the girls at the end deftly and quickly fasten the selvages onto the pins, and when the entire web has been laid on the winch draws it out to the correct width. Each room has two or three sets of frames, so that while one web is drying the girls can be putting on or taking off another web. Owing to the glutinous nature of the dressing it has a tendency to form a film over small mesh goods, so that sometimes the stretched web is beaten lightly with small switches or rubbed gently with fine flannel cloths. In the case of some fine silk nets the unstarched fabric is placed upon the drying and stretching frames and the dressing material applied to the stretched material on the frames.

The drying rooms are usually long, about 100 yards by 15 to 20 yards wide and 9 to 10 feet high, with numerous wide windows and with revolving fans over the frames to assist quick drying. To make good work that will give a clear, crisp, elastic finish with correct weight and "dress" it is necessary to use the correct size required for the particular material, and the temperature and humidity of the drying room is also very important. Although ordinarily fine lace and net

is not heavily starched, in some cases, such as nets to be used for the foundation of bonnets, etc., the material is starched up to four times its original weight.

HIGH TEMPERATURE NOT CONSIDERED UNHEALTHFUL.

The temperature of the lace-dressing rooms is necessarily kept high. This does not exercise any adverse influence on the health of the operatives, as was proved by an investigation made by the British Government in 1906. In fact, it was shown that they are an unusually healthy and long-lived lot. Among those interrogated were found 11 lace dressers who had worked in lace-dressing rooms for over fifty years each, 21 for over forty years, 33 for over thirty years, and 66 for over twenty years. This is probably due to the fact that while the air is relatively dry and high it is pure and plentiful in the working rooms, for the cubic space per operative in such rooms was found to vary from 2,000 to 6,000 cubic feet. The ventilation is always good, as it is necessary to carry off the moist air arising from the drying webs. Though subject to colds at first, the worker's constitution soon gets hardened to it and the conditions seem to make them less subject to lung troubles than workers in ordinary factories.

The windows in these rooms frequently extend to the ceiling and are furnished with pivot sashes horizontally swung, a form of sash which gives a maximum of opening when the casement lies in a horizontal plane. In rooms using the inclosed continuous tentering machine alone the temperature is not more than 80° F., except in the immediate neighborhood of the openings and the feeding end of the machine. In the regular lace-dressing rooms the 1906 inquiry showed the highest temperature found to be 106° and the lowest 67° F., and the driest air discovered contained 27 per cent of saturation and the moistest 53 per cent of saturation.

After bleaching and dressing, the lace is inspected and mended. This is carried on in clean, well-lighted rooms and the girls are very skillful in remedying defects with their needles. For working on white lace the girls often wear blue or black aprons. For scalloped or vandyked edges "clippers" cut around the shaped edges and remove the superfluous material. For clipping off floats as made on fancy lace, etc., the piece is wound between two beams on a small trestle; a yard is unwound at a time and two girls carefully clip off all floating threads and then unwind another yard. Where such floats are in a straight line, as occurs on some types of lace, this can be done by machine. There is less outside clipping work in the Nottingham than in the Calais district, one reason being that net and curtains, that form a good proportion of the Nottingham trade, do not usually have such floats.

The lace is edged by girls called "purlers." Formerly the usual custom was to cut off the projecting threads and then turn down the edges and sew on a tape, but a Singer machine is now largely employed that has been designed to trim, scallop, and overedge the curtains at one operation. Either the tape or an overlock seam can be made as desired.

UNIFORM SALES LISTS.

At St. Gall the United States Treasury agent, after consultation with the manufacturers, etc., makes up a standard list which all have to conform in shipping embroideries

States. Such a system was partially tried at Nottingham for nets, and for a while a committee of two of the leading manufacturers and five of the larger finishers met regularly with the American consul and fixed values for the different grades, and these were adopted as the uniform prices for invoicing goods during the ensuing three months. Quite recently the Nottingham trade has raised objection on the ground that there was no similar system used with their competitors at Calais, so that this system has been temporarily dropped until some uniform method could be invented for all. The last list of uniform prices made up, which, owing to the state of the trade, was much lower than those preceding, is still about the basis on which such goods are now being invoiced and is given below as showing the standard sizes and something of the range of prices:

Schedule for cotton mosquito netting.

Prices are net, with no allowance whatever. Prices are in pence per yard of length and based on a standard width of 240 inches; other widths in proportion. Prices are for white goods, scoured ecru being considered the same as white. The nets are listed according to the number of holes or meshes per square inch.

	Holes.	Price in pence.
Light grade, Nos. 40/60 or 50/60 cotton	16	12½
	17	13½
	18	14
	19	15
	20	16
	21	17
	22	18½
	23	19½
	24	21
	25	22½
	26	24
	27	25
	28	26
	29	28
	30	30

(Arab, 16 to 22 holes, 1½d. extra; Arab, 22 to 26 holes, 1¾d. extra; Arab, above 26 holes, 2d. extra.)

	Holes.	Price in pence.
Double grade, Nos. 30/30 or 28/30 cotton	16	18½
	17	19½
	18	20½
	19	21½
	20	22½
	21	24½
	22	26½
	23	28½
	24	29½
	25	30

(Arab, 3d. extra for fine qualities or 2½d. for slacker.)

	Holes.	Price in pence.
Treble grade, No. 20/20 cotton	16	24
	17	25½
	18	27½
	19	28½
	20	30

(Arab, 4½d. extra.)

Schedule for cotton Mechlin nets.

Prices are net with no discount whatever. Prices are based on standard width of 36 inches and other widths are listed in proportion. Prices are for white goods; black or colors are one-quarter penny extra.

	Holes.	Price in pence.
Coarse cotton Mechlin nets	20	1 11/16
	21	1 7/8
	22	1 7/8
	23	1 15/16
	24	2
These nets are liable to vary two holes, this being unavoidable, bobbin and mosquito.	25	2 1/8
	26	2 1/4
	27	2 3/8
	28	2 3/8
	29	3
	30	3 1/8
	31	3 1/4
	32	3 3/8
Fine cotton Mechlin nets	30	3 1/4
	31	3 3/8
	32	3 3/8
	33	3 3/8
	34	4
These nets usually vary only one hole	35	4 1/8
	36	4 1/4
	37	4 3/8
	38	4 3/8
	39	5
	40	5 1/4

Bobbin bretonne or wash blonde.

Prices are net with no discount whatever. Prices are based on standard width of 36 inches, other widths in proportion. Prices are for white goods; ecru, black, and other colors about one-quarter more. Prices are for goods in boxes; if unboxed about one-eighth less.

Holes.	Price in pence.	Holes.	Price in pence.
18	2	37	5 3/4
19	2 1/4	38	6
20	2 1/2	39	6 1/4
21	2 1/2	40	6 1/2
22	2 3/4	41	7
23	2 3/4	42	7 1/4
24	2 3/4	43	7 1/2
25	3	44	8 1/4
26	3 1/4	45	8 1/2
27	3 1/2	46	8 3/4
28	3 3/4	47	9
29	4	48	9 1/2
30	4 1/4	49	10
31	4 1/2	50	10 1/2
32	4 3/4	51	11
33	4 3/4	52	12 1/4
34	5	53	13 1/4
35	5 1/4	54	14 1/4
36	5 1/2	55	15

WAGE SCHEDULES.

RATES ARE FIXED BY ARBITRATION—COMPREHENSIVE PRICE LISTS FOR EVERY LINE.

In August, 1905, the Board of Trade appointed an arbitrator to settle disputes between the Nottingham Lace Manufacturers' Association and the Amalgamated Society of Operative Lace Makers. After conference with both sides the arbitrator drew up a separate piecework schedule for each of the three branches of the trade, the Levers branch, the plain net branch, and the lace curtain branch. This schedule is now in force and will continue to be in force in the city of Nottingham until October 23, 1910l, when it will be open to revision by either party on two months' notice being given.

LEVERS BRANCH OF THE NOTTINGHAM LACE TRADE.

For the Levers branch the arbitrator divided the laces made into the following 15 classes, with special remunerations for each:

1. Plain bobbin fining goods and banded Valenciennes.
2. Thick threaded bobbin fining goods.
3. Cotton loop lace.
4. Valenciennes made with all independent beams.
5. Gimped Valenciennes.
6. Torchons, guipures, maltese, and Cluny.
7. Silk, Spanish.
8. Blonde laces and streamers, and masque falls.
9. Large silk sprig or striped nets.
10. Spot or sprig nets.
11. Silk veiling and fancy nets.
12. Hamburgs and Russian points.
13. Trimmings.
14. Bagley's.
15. Wool yak laces.

The following general instructions apply to all of the foregoing price lists for Levers lace:

1. All bars at work to be counted, except selvedge bars and bars threaded at brackets only. No bars to be counted twice.
2. When the front bars in Vandyke or Eiffel laces are guimping every motion so as to cover the whole of the pattern with raised floss work, and additional ¼d. per rack for every 10 or portion of 10 bars shall be added to the price.
3. When the bottom jacquard is out of gear, ¼d. per rack shall only be paid for every 100 or portion of 100 threaded bottom bars.
4. When bars threaded are not required in a pattern, and are marked on the dead-stop paper as "in or out," the threads may be left up or pulled down at the discretion of the lace maker to save alteration, but such bars shall not be paid for. The bars marked "in or out" shall only apply to back or center gimps and warp threads.
5. Changing or racking cards, 1d. per rack up to two packs, beyond two packs 1½d. per rack.
6. When making cross bands, ½d. per rack per line up to four lines. No advance beyond four lines.
7. In calculating the length of rack the quality to be measured on the machine, according to the order given.
8. The lace maker may stay one hour after the ordinary time for changing shifts.

9. In case of necessity, as getting a piece off which is urgently needed or to make samples, men working single-handed may stay one hour later than the usual time, such time to be taken off the following day.

10. All materials which have been dyed to represent the natural colors of silk, cotton, wool, or linen shall be paid for as colors.

11. When two colors or shaded threads are worked in the bobbins ¼d. per rack to be paid. When more than two colors or shaded threads are worked in the bobbins ½d. per rack to be paid. When working brown or white with any color or shaded thread in the bobbins these clauses to apply.

Lace makers' working shifts to stop not less than twenty minutes for breakfast, tea, and supper. Single-handed men and lace makers on day work to stop thirty minutes for breakfast and tea, one hour for dinner. The exact hour of stoppage to be arranged by the employer and the shop committee.

No stoppages shall be made for places caused by the fault of the machine, whether it be the jacquards, cards, or other portions of the machinery. Where neglect of the workman cause extra mending, places across or spoiled work, and where a workman fails to carry out written instructions in a workmanlike manner, a claim for stoppage may be made by the employer, but all claims must be supplied in writing with particulars to the shop committee. Unless the shop committee receive such particulars and consent to the stoppage, no stoppage shall be made, and the employer shall be left to such other remedy as may be open to him.

There shall be one learner to every seven or portion of seven men, such learner to serve for four years, and to be paid as follows: For the first two years the learner shall receive one-half the rack price; the third year five-eighths, and for the fourth and last year, three-fourths on one-half the racks made upon the machine in which the learner is placed. The difference to be equally divided between the employer and teacher. The above rule applies to alterations also. In all cases the teacher must be an operative lace maker.

All work when lace makers are not making racks shall be called "day work" (except tying in warps or reentering instead of tying in), and shall be paid for at the rate of 5s. per day of ten hours.

When five consecutive hours are made in any alteration the time to be paid for as half a day. Saturday shall be paid for as a full day when two other full days have been worked in the same week. When less than two full days have been worked, Saturday shall be paid for as half a day.

The foregoing are the shop rules for Levers machine work. The system of payment according to the decision of the arbitrator is shown by the complete list for the first article, which is as follows:

I. Plain bobbin fining goods and banded Valenciennes.

(Without thick threads, lining threads or gimps; made with top or top and bottom bars.)

Standards: Rack 1,920 motions; gage, 10 points; width of machine above 18 and below 20 quarters of a yard; quality from 9 to 15 inches, inclusive; bars up to and including 80—all top net bars (not inclusive of net bars traversing more than 5 gates), backs, fronts, and band threads to be counted as bars, price fivepence halfpenny per rack; minimum price for any width or gage, fourpence halfpenny per rack.

Bars: For every 20 or portion of 20 bars over 80, one farthing per rack; for every 50 or portion of 50 bottom bars up to 600, one farthing per rack, no advance beyond 600; for every 10 or portion of 10 net bars traversing more than 5 gates, one farthing per rack; for every 10 or portion of 10 straight threads in a breadth not thicker than 60/3 or its equivalent, one-eighth per rack; coarser than 60/3 or its equivalent, for every 10 or portion of 10, one farthing per rack.

Fluctuations: (1) Gages above 10 points up to and including 12 points 1 farthing per gage to be added; beyond 12 points 1 farthing per half gage to be added; and gages below 10 points 1 farthing to be deducted—no deduction below 8 points; (2) quality below 9 inches to 8 inches, inclusive, 1 farthing per rack to be deducted; below 8 inches a further farthing to be deducted; quality above 15 inches to 20 inches, inclusive, 1 farthing per rack to be added; above 20 inches a further farthing to be added; (3) for 16 quarters and above 16 quarters up to 18 quarters, inclusive, 1 farthing per rack to be deducted; below 16 quarters a further farthing to be deducted; for 20 quarters and below 22 quarters 1 farthing per rack to be added; for 22 quarters and above a further farthing to be added. Extras: (1) Black, pearl white, all silk, 1 penny per rack; (2) silk, tussah, wool, or China grass worked from 'n

pendent beams, one-eighth of a penny per rack per thread up to 4 threads in a breadth, no advance beyond 4 threads; when black, pearl white, silk, tussah, wool, or China grass are confined to the bobbins, 1 halfpenny per rack only to be added; (3) when in making cotton goods silk is used in lacers and draw threads only, 1 farthing per rack to be added; (4) lacing threads on the net, 1 farthing per rack; (5) when using whipper bobbins, 1 farthing per rack to be added.

In the above, "quarters" refer to the width of the machine in quarters of a yard. "Quality" refers to the number of inches of lace produced per rack of 1,920 motions.

PLAIN-NET BRANCH OF THE NOTTINGHAM LACE TRADE.

By agreement between the Nottingham Lace Manufacturers' Association and the Amalgamated Society of Operative Lace Makers an arbitrator was called in to settle wage disputes and he made up price lists for the following classes of nets:

Circular lace machine making plain nets.
Stiff quality plain nets: (*a*) with double cotton in bobbins, (*b*) with single cotton in bobbins.
Coarse gages.
Making quilling: (*a*) cotton quillings, (*b*) silk quillings.
Brussels or five twist.
Mechlin nets: (*a*) 12-motion cotton mechlin, (*b*) 20-motion cotton mechlin, (*c*) 12-motion silk mechlin, single tier, (*d*) 12-motion silk mechlin, double tier, (*e*) 20-motion silk mechlin.
Circular machines making diamonds.
Sprig net, with traverse ground.
Traverse net, with spotting: (*a*) silk goods, (*b*) cotton goods.

The following general instructions apply to all of above:

When a lace maker in the plain net section is employed otherwise than in making lace in a machine, such employment shall be termed day work; the term day work shall include springing carriages when altering from one class of goods to another, reentering parts of beams or warps knocked down through no fault of the employee, or reentering warps cut out before being emptied; day work shall be paid for at the rate of 5s. per day of ten hours when all the machines are standing, and a proportion of this when one or more machines are going.

Short alterations: (1) When five consecutive hours are made in any alteration the time shall be paid for as half a day; (2) Saturday shall be paid for as a full day when two other full days have been worked in the same week; when less than two full days have been worked, Saturday shall be paid for as half a day; (3) the lace maker may stay one hour after the ordinary time for changing shifts; (4) in case of necessity, as getting off a piece urgently needed or to make samples, men working single-handed may stay one hour later than the usual time, such time to be taken off the following day; (5) the foregoing rules are to be generally recognized as shop rules for the whole trade; any other shop rules in any particular shop must be such as are agreed to by the employer and employees.

Minors, working in plain net branch: The full rack price to be paid to the machine; there shall be one learner to every seven or portion of seven men, such learner to serve for four years, and to be paid as follows: For the first three months, 3d. in the shilling, and for the last nine months of the first year, 4d. in the shilling; 4½d. the second year; 5d. the third year, and 5½d. the last year; providing a minor when put in the machines be under 18 years of age, he must attain the age of 19 before he receives 4½d. in the shilling; any person introduced into the trade shall, after having served four years in a machine, in any branch or branches of the trade, be considered a competent lace maker; the teacher shall undertake the general management of the machine, shall be responsible for the quality of lace made, and also for the orders being executed correctly and in a workmanlike manner.

CIRCULAR LACE MACHINES MAKING PLAIN NETS.

The system of payment in the plain net branch is shown by the following price list, standard rack, 240 holes:

(1) Twelve quarters, 10 points, brown cotton plain net, eleven-sixteenths of a penny per rack, and one-sixteenth of a penny in addition for every 13½ inches in width above a 12 quarter. The following clause applies only to plain nets, quillings, tapes, and mechlins: No extras to be paid when working 40s or 50s, single cotton in the bobbins; when working over 50s up to 80s, inclusive, one-sixteenth extra, and when beyond 80s, one-eighth extra. All machines working with single cotton on the warp, one-eighth extra. (2) Twelve quarters, 10 points, making plain silk goods in natural colors (white or yellow), seven-eighths of a penny per rack; 12 quarters, 10 points, making queen's or other breadths, 1d. per rack; and to be raised one-sixteenth of a penny per quarter of 9 inches on all machines above 12 quarters making silk. (3) For taping up to three-quarters of a bar, 1 farthing per rack extra; from three-quarters of a bar up to craping, three-eighths of a penny per rack extra; for craping, seven-sixteenths of a penny per rack extra. (4) When working jacked-off silk, one-eighth of a penny per rack extra. (5) All odd inches in the machines to be added together and if they amount to 6 inches, to be paid for as 13½ inches. (6) All machines working half gage to be paid for at the same rate as if working full gage.

LACE-CURTAIN BRANCH OF THE NOTTINGHAM LACE TRADE.

By agreement between the Nottingham Lace Manufacturers' Association and the Amalgamated Society of Operative Lace Makers an arbitrator was called in to settle wage disputes, and he made up price lists for the following classes of curtains:

Three-gate curtains; four-gate curtains; three-gate curtains, muslin goods made with one bar only not full threaded; three-gate curtains, muslin goods made with one full threaded bar; three-gate curtains, muslin goods made with two bars, not full threaded; swiss curtains; combination and madras curtains; three-gate purls and scollops, laces, and hamburgh nets; three-gate silk nets.

The following general instructions apply to all of above:

Alterations: All work when lace makers are not making racks shall be called "day work" (except when tying in main warps or reentering instead of tying in) and shall be paid for at the rate of 5s. per day; when a warp is cut out before being entered, the fresh warp shall be paid under short alterations, but the warp cut out shall not be paid for when reentered if the warp in the machine is emptied.

Short alterations: When five consecutive hours are made in any alteration the time to be paid for as half a day; when more than two lace makers are employed on short alterations in one machine each man shall be paid 6d. an hour; Saturday shall be paid for as a full day when two other full days have been worked in the same week, but when less than two full days have been worked the Saturday must be paid for as half a day; when short alterations have to be made it shall be permissible for the lace maker to come one hour before the ordinary time or stay one hour after the ordinary time for changing shifts; it is also permissible for single-handed men to come half an hour earlier or stay half an hour later in order to get a piece off which is wanted or to get out a sample, the time so made to be lost within seven days; no shop rules, except those as now made, will be recognized unless agreed to by the employers and employees.

Learners: That there shall be one learner to every seven men or portion of seven men, such learner to serve for four years and to be paid as follows: For the first two years the learner shall receive five-eighths of the rack price, the third year six-eighths, and for the fourth and last year seven-eighths on one-half the racks made upon the machine in which the learner is placed, the difference to be equally divided between employer and teacher; in all cases the teacher must be an operative lace maker.

The system of payment in the lace curtain branch is shown by the following example. (In this list the prices are given in pennies and thirty-seconds of a penny per rack. Thus on a machine 15 quarters

(of a yard) wide, 5-point gage, the price per rack paid the lace maker is seen to be 1^{18}d. per rack, that is, $1\frac{18}{32}$d., etc.):

STANDARD I.—*Prices for three-gate curtains.*

Quarters.	Gage.											
	5	6	7	8	9	10	11	12	13	14	15	16
15...	1^{18}	1^{18}	1^{19}	1^{20}	1^{21}	1^{25}	1^{27}	1^{27}	1^{29}	1^{31}	2^{2}	2^{4}
16...	1^{19}	1^{20}	1^{21}	1^{22}	1^{23}	1^{27}	1^{28}	1^{29}	1^{31}	2	2^{4}	2^{6}
17...	1^{21}	1^{22}	1^{23}	1^{23}	1^{24}	1^{28}	1^{30}	1^{31}	2	2^{2}	2^{6}	2^{8}
18...	1^{23}	1^{23}	1^{24}	1^{25}	1^{26}	1^{30}	1^{31}	2	2^{2}	2^{4}	2^{8}	2^{10}
19...	1^{25}	1^{25}	1^{26}	1^{27}	1^{27}	1^{31}	2^{1}	2^{2}	2^{4}	2^{6}	2^{10}	2^{11}
20...	1^{26}	1^{27}	1^{27}	1^{28}	1^{28}	2	2^{3}	2^{4}	2^{6}	2^{8}	2^{12}	2^{13}
21...	1^{27}	1^{28}	1^{28}	1^{29}	1^{30}	2^{2}	2^{5}	2^{6}	2^{8}	2^{9}	2^{13}	2^{15}
22...	1^{28}	1^{29}	1^{30}	1^{31}	2	2^{4}	2^{7}	2^{8}	2^{9}	2^{11}	2^{15}	2^{17}
23...	1^{30}	1^{31}	2	2	2^{1}	2^{6}	2^{8}	2^{9}	2^{11}	2^{13}	2^{17}	2^{19}
24...	2	2	2^{1}	2^{1}	2^{2}	2^{7}	2^{10}	2^{11}	2^{13}	2^{15}	2^{19}	2^{20}
25...	2^{1}	2^{1}	2^{2}	2^{3}	2^{4}	2^{9}	2^{12}	2^{13}	2^{15}	2^{17}	2^{20}	2^{22}
26...	2^{2}	2^{3}	2^{4}	2^{5}	2^{6}	2^{11}	2^{14}	2^{15}	2^{17}	2^{18}	2^{22}	2^{24}
27...	2^{4}	2^{5}	2^{6}	2^{6}	2^{7}	2^{13}	2^{16}	2^{17}	2^{18}	2^{20}	2^{24}	2^{26}
28...	2^{6}	2^{6}	27	2^{8}	2^{9}	2^{14}	2^{17}	2^{18}	2^{20}	2^{22}	2^{26}	2^{27}
29...	2^{6}	2^{6}	2^{7}	2^{8}	2^{9}	2^{14}	2^{17}	2^{18}	2^{20}	2^{22}	2^{26}	2^{27}
30...	2^{7}	2^{8}	2^{9}	2^{10}	2^{10}	2^{16}	2^{19}	2^{20}	2^{22}	2^{23}	2^{26}	2^{28}
31...	2^{9}	2^{10}	2^{10}	2^{11}	2^{12}	2^{18}	2^{21}	2^{22}	2^{23}	2^{24}	2^{28}	2^{30}
32...	2^{10}	2^{11}	2^{12}	2^{13}	2^{14}	2^{19}	2^{22}	2^{23}	2^{24}	2^{26}	2^{30}	3
33...	2^{12}	2^{13}	2^{14}	2^{15}	2^{16}	2^{21}	2^{23}	2^{24}	2^{26}	2^{28}	3	3^{2}
34...	2^{14}	2^{15}	2^{16}	2^{16}	2^{17}	2^{22}	2^{25}	2^{26}	2^{28}	2^{29}	3^{2}	3^{3}
35...	2^{16}	2^{16}	2^{17}	2^{18}	2^{18}	2^{23}	2^{27}	2^{28}	2^{29}	2^{31}	3^{3}	3^{5}
36...	2^{17}	2^{18}	2^{18}	2^{19}	2^{20}	2^{25}	2^{28}	2^{29}	2^{31}	3	3^{5}	3^{7}
37...	2^{18}	2^{19}	2^{20}	2^{20}	2^{21}	2^{27}	2^{30}	2^{31}	3	3^{2}	3^{7}	3^{9}
38...	2^{20}	2^{20}	2^{21}	2^{22}	2^{22}	2^{29}	2^{31}	3	3^{2}	3^{4}	3^{9}	3^{10}
39...	2^{21}	2^{22}	2^{22}	2^{23}	2^{24}	2^{30}	3^{1}	3^{2}	3^{4}	3^{6}	3^{10}	3^{11}
40...	2^{22}	2^{23}	2^{24}	2^{25}	2^{25}	3	3^{3}	3^{4}	3^{6}	3^{8}	3^{11}	3^{13}

All widths above 40 quarters up to and including 12 points to advance $\frac{3}{32}$d. per quarter and 1/32 per gage; above 12 points and up to 16 to advance 2/32 per quarter and 2/32 per gage.

All curtains up to and including 8 points, when punched straight through, to be paid as curtain net, and above 8 points to be paid 3/32 of a penny more than curtain net.

Additions to the three-gate curtain card: (1) Two-gate to be paid 7/32 of a penny less, and four-gate 7/32 of a penny extra; (2) all unfinished goods where change of cards is not required be paid 7/32 of a penny less; (3) toilets, bed covers, eider downs, etc., either made with or without turn-again tackle, 3/32 of a penny less than curtains; (4) all goods made with one lacing thread of 18 inches or under 6/32 of a penny extra; above 18 inches nothing extra. Lacing threads in dressing selvages not to be paid for.

Extras for making colors in cotton only: (1) Where one color and up to three colors 23/32 of a penny per rack extra to be paid; where more than three colors $1\frac{3}{32}$ extra to be paid; (2) if colors are worked on warp or in bobbins, or both, 7/32 of a penny extra to be paid; (3) when working colors on less than full width to be paid in proportion to the number of breadths in which colors are introduced.

OPERATIVES AND LIVING CONDITIONS.

BETTER PAID THAN CALAIS WORKERS—INCOME AND EXPENSES—LABOR ORGANIZATION.

The population of Nottingham in 1908 is estimated to be in the neighborhood of 255,000. The town is dependent on the lace and hosiery trades, and to a large extent the fluctuations of population are a measure of the prosperity of these trades. In 1831, on the expiration of the patent rights on Heathcote's lace machine, there was a sudden increase in lace manufacturing and a great influx of workers to take part in the rapidly expanding business. This growth and attendant prosperity lasted until the American civil war, when there was a depression that extended over some dozen years. There was then renewed prosperity to 1883, when another depression set in. From this the industry gradually recovered and was put on a larger and more stable basis, but it is now hardly holding its own, for the tariff barriers in foreign countries and the steadily increasing French industry tend to prevent any great expansion.

The French, with their more artistic, cheaper, and almost as efficient workers, have taken the lead in the production of fancy laces and will possibly, in time, also in that of net, though in both net and curtains the English industry is still the largest. On account of lower taxes and less union restrictions in the country and suburbs, the lace factories now show a strong tendency to move outside of Nottingham. Thus the union, for instance, attempts to limit the length of the machines to be worked and these are so strong in Nottingham that they can control, while outside their power is weaker, so that most of the newer long machines are now installed at Long Eaton and other places farther removed from the power of the cental union.

PROPORTION OF LACE WORKERS.

In Nottingham the proportion of females is higher than in the population of the country as a whole, there being 114.6 to 100 males, while the population of England and Wales, as a whole, shows 106.7 females to 100 males. The large number of women employed in the lace and hosiery trades probably attracts women from the other towns, for the larger proportion of the female population are workers. The census of 1901, for instance, showed that of 27,819 females in Nottingham between 15 and 25 there were 21,566 engaged in some occupation, 7,942 being in the lace and hosiery trades alone. The percentage of wives and widows working was 24.1 per cent, which is an unusually large proportion.

Of the total population of the town in 1901 there were 14,701 women and 6,925 men returned as engaged in lace manufacturing, but this did not include many engaged in allied trades, such as dyeing, etc., which do work for both the lace and outside trades.

At least two-thirds of the workers in lace factories in Nottingham are women, whereas in Calais it is estimated that less than one-half are women. In both cases the twist hands are always men, which is partly due to the fact that in normal times the factories work night and day, and in both countries women are forbidden to work at night.

Both at Calais and at Nottingham there is a large industry carried on at home in cutting apart the lace, clipping off floating threads, etc., but this is much smaller at Nottingham than at Calais. The Nottingham work is more factory work, for most of the net and curtains made need little or none of this work, and even on the fancy lace the manufacturers are not able to find the same class as the skillful French home workers to which to trust the material, and hence do much of it in the factory.

The lace factories of Nottingham are now running short time, owing to the financial state of the world, but in ordinary times they run 20 hours a day, as do the French. In France, however, the two shifts seem ordinarily to work alternatively four and six hours and six and four hours, while the two English shifts work alternately five hours regularly, but there is no uniformity about this, and some work one method and some the other. In both countries the factories in normal times run one hundred and twenty hours a week, starting at 4 a. m. and stopping at midnight, though in very flush times some work twenty-four hours a day.

COMPARISON OF CONDITIONS.

To compare the actual condition of the Nottingham lace workers with the Calais lace workers is rather difficult, owing to the fact that the two bodies of workers live differently and their requirements are different. In normal times there are fewer unemployed at Calais than at Nottingham, and the operatives seem to enjoy life just as much, but if they be compared on the same scale of living the English operative is much better off. In general it seems to be correct to say that the Nottingham workers get nearly a fifth more wages than the Calais workers, while their food and clothes of the same quality will be found cheaper at Nottingham than at Calais. The English operatives indulge in meat frequently, the French very rarely. Highly skilled twist hands, "tullistes" they are called at Calais, will get fully as high wages at Calais as at Nottingham, while very skilled designers seem to get even better wages, which is evidenced by the fact that some of the best designers at Calais are English, but on the whole the workers do not have as large a margin between wages and the necessary costs of living at Calais as at Nottingham.

In regard to wages, taking the two extremes, the twist hands and the bobbin fillers, we find that the ordinary first-class French twist hand operating a Levers lace machine will make about 50 francs ($9.65) a week and the similar English twist hand about 50 shillings ($12.16). The French boy for running the threads into the bobbins is paid 50 centimes (9.65 cents) a thousand and the English boy 6½d. (13 cents) a thousand. These two examples seem to show the difference in level of the wages though in certain of the subordinate occupations there does not seem to be much difference.

COST OF LIVING.

In regard to cost of food stuffs the following is a list of articles that I personally priced in the two towns at stores patronized by the operatives, both being given in cents per pound.

Articles.	Calais.	Nottingham.	Articles.	Calais.	Nottingham.
Bread	3.25	2.50	Sugar	6.14	5.00
Beef	17.50	16.00	Cheese	19.30	16.00
Pork	17.50	15.00	Butter	24.60	27.00
Flour	4.40	2.86	Milk, per quart	5.50	8.00
Potatoes	1.75	.86			

It is seen that in most instances the Nottingham operative has the advantage of cheaper food, and with his smaller wages the Calais operative is compelled to offset this by eating less of meat and more of vegetables. Beef, etc., is sold in France by the kilo and in England by the pound. Bread is sold in England by the 4-pound loaf and at Nottingham a loaf costs 4½ to 5½d. with average about 5d. (10 cents). In Dundee, where food costs higher than in any other industrial town in Great Britain, similar loaves cost 6d. (12 cents). Potatoes, flour, etc., are sold in Nottingham by the half-stone of 7 pounds. The French operative pays the high price of 4 francs a kilo (35 cents a pound) for coffee, and the English operative pays 36 cents a pound for tea. The kerosene oil used at Calais costs 30 centimes a liter (5.8 cents a quart), while the paraffine oil largely used at Nottingham costs 16 cents a quart. Coal is cheaper in Nottingham than in most parts of England, selling by the hundredweight at 8½d. to 10d. (17 to 20 cents), while in Calais the retail price is over twice as high.

HOUSING OF OPERATIVES.

In regard to housing conditions at Nottingham they are on the whole very good. The poorer-paid operatives, especially those who live near the older and more crowded sections of the town, are very crowded and in unsanitary quarters, but the twist hands, especially those who live in the newer suburbs, have very pleasant homes. It may be noted that the English textile operative refuses to live in flats, such as are universal in Saxony and in many other parts of the continent, but always wants a home with a front door of his own. (To anyone who has ever been in England it is unnecessary to mention that buildings are always of brick or stone, for a frame dwelling anywhere in England is almost a curiosity.) Dundee is one of the few textile towns of Great Britain where the tenement-house system flourishes.

At Nottingham the old type of houses are three-room "back to back" and five-room "through" houses. The old back-to-back houses have no rear entrance, and the front door usually opens into the kitchen or living room, whence a stairway leads to the rooms on the upper floor, there being three stories in all. The "through" houses have a back entrance. The "back-to-back" type of house is common in the older parts of the city, and is usually unsanitary and inconveniently arranged.

The newer types of houses for workers at Nottingham, especially those in the newer sections of the towns and the suburbs, are always built in what is called the "terrace" style. Instead of blocks with houses facing the street from all four sides of the square there are

FIG. 7.—Typical Nottingham lace mill, with rear view of 5-room dwellings used by lace makers.

rows of houses rising in terraces one above the other. Usually there is a paved alleyway between each two rows with streets on each side of the two rows. These rows of houses usually have no front

FIG. 8.—A typical "terrace" row of houses as occupied by Nottingham lace makers.

yard, but at the back there is usually a fair sized space, which is sometimes divided off for each house and sometimes used in common. Figure 8 shows the front of a typical row of a "terrace," this picture being taken of houses occupied by "twist hands" working in a

neighboring lace mill. In some cases there is now left a 10-foot space in front of the houses for a front yard, and in such cases they are often filled with flowers by the wives of the lace makers.

These newer types of houses are either three, four, or five room. Figure 8 shows the four-room type built in two stories with narrow front containing a parlor or living room and a kitchen on the first floor and two bedrooms upstairs. A small scullery is sometimes but not invariably built out from the kitchen. Figure 7, which gives a view of a typical Nottingham lace factory, also shows a rear view of the typical five-room "terraced" houses. These are becoming the predominant type of the new dwellings, and are made with parlor and kitchen on the first floor, two bedrooms on the second, and an attic above. Here again the front door opens directly into the parlor, and there is usually a small scullery behind the kitchen and a small inclosed back yard.

Six-room houses are rarely occupied by workers except such higher paid men as foremen and clerks. Detached houses are extremely rare as the houses are all built end to end in terraces.

RENTS AND TAXATION.

The predominant range of weekly rents for the different size houses are as follows:

Number of rooms.	Rents.
Three rooms	$0.85 to $1.15
Four rooms	1.10 to 1.28
Five rooms	1.22 to 1.70
Six rooms	1.58 to 2.30

It is seen that the average rent per room per week is about 35 cents. As a rule, the operatives are not very crowded.

At Nottingham the town owns much property, and the rent from these are used to reduce the rates of taxation. The town also owns most of its public utilities, such as the water supply, drainage works, gas and electric supply, baths, cemeteries, extensive markets, hospitals, a lunatic asylum, etc., and has many parks and breathing spaces. In sewerage works the town is very deficient, as these have been extended to but a small portion of the incorporated limits, and this fact is stated by a recent report of the medical authorities to be one of the main causes of much of the sickness. The use of gas is extending, and is now installed in most of the newer type of workmens' dwellings. An automatic "penny-in-the-slot" meter is used in such cases.

LABOR UNIONS.

The higher-paid workers in the Nottingham lace factories—such as the twist hands or "lace makers"—are very strongly organized, and as the independence and jealousy of the manufacturers prevent their having any similar alliance except temporarily, the unions usually dominate the situation.

The secretary of the "Amalgamated Society of Operative Lacemakers" states that there are 2,000 twist hands in the Levers branch

in his union and 550 twist hands of the plain net branch, with smaller numbers engaged in the curtain branch, and that 99 per cent of the twist hands of Nottingham belong to this organization. The poorer paid workers, consisting largely of women, are not so strongly organized. This union belongs to the International Federation of Lace Makers, and is the wealthiest branch, but, owing to some differences at a meeting this year at Calais, they have temporarily withdrawn. The income of this union, including their branches at Beeston, Ilkeston, Long Eaton, Draycott, and Sandiacre, for the half year ending June 30, 1908, amounted to £6,668–12 ($32,452), and their surplus cash in bank at this time was given as £10,071 ($49,010). This union pays its superannuated members, of which there is now 180 on the list, 85 cents each a week, and they also pay either in whole or in part, in special cases, for sending their members to sanatoriums, convalescent homes, etc., for dispensary charges, etc., and also allow out-of-work pay. Just at the present time, owing to the depressed condition of the trade, this latter amounts to a large sum.

CONSULAR REPORT.

HOME WORK IN THE NOTTINGHAM LACE INDUSTRY.

Consul Frank W. Mahin, of Nottingham, sends the following report on the investigation by the British Government into the question of home work in the lace industry:

An inquiry by Parliament into home work—i. e., work on articles taken home from factories, etc., by women and done by them and their children at home—has recently been held, with a view to a possible law to better the condition of the workers and to correct abuses. Much evidence was given by expert witnesses. The lace industry was one of the subjects investigated. According to the evidence, 7,700 home workers in Nottingham are engaged on laces—clipping, scalloping, and drawing out superfluous threads. The work reaches them through middle women, who receive a commission of about 25 per cent of the compensation allowed by the manufacturers for the work, for taking the laces to and returning them from the home workers. These middle women are considered a necessity, as they save time to both workers and employers, and are responsible for the selection of competent workers in wholesome surroundings, and for damage to goods and poor service. They are sometimes charged with retaining extortionate commissions, but this is apparently not well founded.

The home work evidently induces household and personal cleanliness, which is usually a condition precedent to receiving work. Charges of sweating are denied by the manufacturers, though undeniably the wages paid the workers are small. They earn from 2 to 8 cents an hour, varying with the class of lace and the rapidity of the worker. Some workers make their living from this employment, but it seems that the most expert can not earn more than $4 a week. The majority, however, are women who work in spare moments, assisted by their children before and after school hours. In many cases these women have husbands earning in other ways enough to

support the family, when the women's earnings are only supplementary. This is one cause of the low wages paid for the home work. A serious objection made to home work is that it detracts from the diligence of some husbands.

Allegations of excessive use of child labor in home work are often made, but these are denied by the manufacturers and by investigators. It is admitted that child labor is employed to an unusual extent in Nottingham, but this is due to the character of the work, which a child can do easily.

An important question considered by the parliamentary committee was whether or not it would promote cleanliness and prevent abuses if a government license for home work were required, necessarily preceded by approval of the proposed licensee. Expert evidence generally was to the effect that it would be impracticable, prove needlessly restrictive and burdensome, and be detrimental to home workers, as employers would tire of the continual inspections and cease giving out work. Workers themselves take a similar view, evidently believing they would fare better, on the whole, without government intervention.

Local newspapers have interviewed manufacturers, middle women, and home workers. Discordant opinions were given. But a broad general view of the subject appears to induce the belief that home work, as conducted at Nottingham in the lace trade, is to the interest of both employer and employed, and that it would be hurt more than helped by government intervention.

LACE MAKING AT CALAIS

DEVELOPMENT OF LACE MAKING.

EARLY BECAME CENTERED AT CALAIS—GREATLY AIDED BY THE JACQUARD ATTACHMENT.

In the production of fancy laces Calais leads the world, and great fortunes have been made here in manufacturing lace for the American trade. Started in 1816 it has especially prospered in the last ten years, and men who were working as machinists or "tullistes" five or ten years ago now own plants worth millions of francs. The trade is steadily increasing, which means that the United States is buying increased quantities, as three-fourths of the Calais export is taken by this one country.

Lace is made at Calais, Caudry, St. Quentin, Lyon, Lille, and St. Chamond, but Calais and Caudry are the two main centers, both in the Department of Pas-de-Calais.

The official figures for the export of cotton manufactures from France in 1907 showed 1,872,739 pounds of machine-made lace, of a value of $12,604,830, or $6.73 a pound. There is also shown $2,873,384 of tulle and $578,614 worth of tulle curtains of cotton, besides $4,849,511 of silk laces. These are the figures for the direct export, and do not include the large amount of laces of all kinds sent to the shops and dressmakers of Paris, which eventually reach the United States without being recorded by the customs. The total export of articles made on the lace machines of France may be conservatively estimated at $25,000,000 a year. A French inspector estimates the lace production of Calais district alone at between 100,000,000 and 120,000,000 francs in good years. The bulk of the lace that is left after the United States has finished her buying goes to Great Britain and Germany, with smaller amounts to every other section of the globe.

HISTORY OF THE INDUSTRY.

This important industry of lace making dates from 1816, when it was smuggled over from England. Before that time there was no machine-made lace of French manufacture. The French had many single-loop net machines—based on the principle of the stocking frame—and to encourage its manufacture Napoleon, in 1802, prohibited the importation of the competing English articles. This made machine net and hand-made lace high priced, and in the meantime the English had invented a machine to make bobbinet that was a great improvement on all existing machines. It became clear to both English and French that the first factory to start such machines in France would make big profits, but the English manufacturers wanted no competitor. They desired to preserve the monopoly of the machines and machine-made articles that they had developed, and long existing acts of Parliament had prohibited the

export of machinery of various kinds. That of William III, of 1695, fined exporters of knitting machines £200 and punished them with twelve months' imprisonment, and this was extended in 1718 to all other kinds of machinery used in the manufacture of silk, cotton, and linen manufactures, adding a penalty of £500 on persons inducing artificers to leave the Kingdom. These acts were confirmed during the next sixty-six years, and in 1785 further extended to include engines, tools, and utensils used in constructing machines, and anyone exporting such machinery was further punished with deportation.

After the Napoleonic wars these laws were relaxed so that machinery could be exported on special permit, and in 1825 that part which prohibited emigration of skilled workers was repealed, but it was as late as 1841 before the laws forbidding machinery exportation were finally annulled. In 1816 the first lace machines were smuggled into France by dismantling the separate parts and mixing with a lot of old iron, and workers were also smuggled across the Channel. Cutts, at Douai, and James Clark, at Calais, both claim the credit of starting the first lace machine in France.

PRESENT LOCATION AND IMPORTANCE.

The industry gradually prospered and became centered at the town of Calais, but in 1832 the citizens objected so strongly to having their rest at night broken by the clack of the machines that the municipality forbade night work, and the factories gradually drifted to the suburb of St. Pierre-de-Calais, where it has remained ever since, though later developing large subcenters at Caudry and elsewhere. The French at that time made no high-grade yarn, and this was smuggled in from England in spite of the laws. In 1834 the prohibition against importing English cottons was raised, but the customs were strengthened and a high duty imposed, so that the result was to paralyze the industry.

About this time came the application of the Jacquard to the lace machine, which aided the industry by raising the price of the article and extending its range, so that after a period of depression lace making recovered and has steadily increased ever since. In 1850 the industry was almost wholly at St. Pierre and comprised 428 machines. In 1870 there were 939, and in 1908 there are now in and around Calais 2,615.

SOME GRIEVANCES OF THE MANUFACTURERS.

In 1892 France passed a new tariff raising the duty on cotton yarn. This was bitterly opposed by the Calais manufacturers, as they wanted yarn free, and stated that if they could get the superior English yarn free of duty they could also stand all competition due to lace coming in free of duty. Nottingham and Calais manufacturers have always consistently fought for free exchange of commodities required in their business. The law was made in the interests of the yarn mills at Lille and Tourcoing, and since then these mills have been able to extend their range of numbers until they make a good portion of the fine yarns required, though much is still obtained from England.

To aid the Calais manufacturers in meeting the increased cost of their materials, the French Chamber granted a special rebate of the duty supposedly paid on yarn contained in the laces exported, and in some cases the waste and cutting was also counted for 25 per cent. This was intended to aid the manufacturers, but they claim never to have received any benefit from it, as it is the buyers and commission houses who obtain the drawback, and in fact some of the buying houses pay the expenses of keeping up branch establishments at Calais out of the rebates thus granted on materials exported.

The Calais manufacturers also strongly opposed the proposed law restricting the hours of work of women and children to ten and forbidding them night work. The result, however, has been to benefit the trade in some particulars since its passage in 1892, for as tulle and lace machines run night and day with shifts, it practically confined the actual machine running to men over 18, and the boys were thus forced to work an apprenticeship in other lines of the work before taking charge of a machine, which made them when they finally graduated into work as full-fledged "tullistes" much more efficient. This restriction and the high duty are still held as burning grievances by many of the manufacturers.

GROWTH OF INDUSTRY.

The rapid progress of the Calais industry in recent years, as shown by figures furnished by the manufacturers' association, is as follows:

Description.	1905.	1906.	1907.	1908.
Manufacturers	365	365	500	584
Machines	1,867	2,227	2,367	2,615

The number of tullistes at Calais is now given as 7,700, and the total of factory workers of all kinds as 31,600, but this does not include the outside workers engaged in clipping, etc., which it is estimated would swell the total to two or three times this number.

The Calais lace industry pays its skilled labor higher than do most other industries in France and so obtains the best. The employers who are themselves in large part old workmen from all branches of the profession, are inventive and shrewd. Since the inception of the industry in 1816 the Calais manufacturers have rivaled Nottingham in the number of their inventions and adaptations, and, in fact, while the bobbinet machine is an English invention, the lace machine is a French invention, for it was only by the ingenious combination of the Jacquard with the bobbinet machine in France in 1834 that there was enabled to be produced the present machine-made imitations of genuine hand lace.

The superior taste of the French and their adaptiveness has developed the fancy lace side of the industry until now they surpass Nottingham, which has developed on their side more of the less artistic net and lace curtain part of the industry. Calais makes mainly narrow laces for the ornamentation of the costumes, coiffures, and clothing of the feminine sex, their perfection being most marked in such specialties as Valenciennes, Malines, and Chantilly. Large quantities of this lace is sold to the great stores and dressmakers of Paris, but the bulk is sold to commission houses, to whom the manufacturers

give varying rates of discount. There are usually three or four discounts, and among the buyers the talk is always as to who is getting the most discounts.

SKILLED LABOR COMMANDS HIGH PAY.

The French tullistes are a skilled set of workmen and they have energy and perseverance, are economical, and usually contented. They are independent, however, and hard to manage by one not accustomed to their ways of looking at things. They live well and a sight of the streets on Sunday afternoons show that they and their families can dress well. The French worker takes his family with him everywhere and they share their pleasures together. The workers at Calais, due to the higher wages paid the skilled classes, have more social enjoyments than usual among the working classes; they have numerous singing societies, bands, etc., and get up balls and fêtes. They also have fraternal and mutual benefit associations.

The designers, tullistes, machinists, and similar skilled men get good wages at Calais, but the less skilled workers have to be content with very little. Where a tulliste will make from 10 to 20 francs a day, the less skilled factory workers and the cutters will do well to get from 1 to 3 francs a day. Though the skilled classes live well, the poorer have to be very economical and to live on little meat, for Calais is one of the highest-priced food centers of Europe.

At Calais the employers and employees are both strongly organized. There are three employers' organizations, namely, L'Association des Usiniers Louers de Force Motrice, founded in 1895; La Chambre Syndicale des Fabricants de Tulles et Dentelles, founded in 1883, and comprising the principal manufacturers; and L'Association des Fabricants de Tulles et Dentelles de Calais, founded in 1900 at the end of the great strike. The last-named association embraces most of the manufacturers and is the most important.

The manufacturers publish a "Bulletin Mensuel" of 8 pages, in which they give news of the trade at Calais, Caudry, Plauen, and Nottingham, and statements of the conditioning tests.

CONDITIONING HALLS—LABOR UNIONS.

The Chamber of Commerce at Calais maintains an official "Condition publique des soies, des laines et des cotons." The strength, weight, and length of fine cotton and silk yarns such as are used in the lace industry will vary according to the atmosphere, and to get best results they should be maintained and be manufactured at a normal temperature and contain their normal amount of moisture. Condition halls for this purpose were established at Turin in 1750, and later at Lyon, St. Etienne, St. Chamond, and finally at Calais, the latter being made an official work and placed in charge of the Chamber of Commerce by the French Government in 1886. The operations of the condition house consist in storing materials for the manufacturers at a fixed temperature so as to preserve them in best conditions of humidity, etc., testing for number, weight, twist, percentage moisture, etc. This public conditioning house is very useful to the trade.

On the side of the employees there are two main organizations: L'Emancipation, which has its headquarters at the Bourse du Travail,

founded in 1900 and having about 1,500 members; and L'Union Française des Ouvriers Tullistes, a syndicate independent of the Bourse, founded in 1888, and having about 1,700 members. This union is the most active and also conducts a cooperative agency with some success.

Exceptional high-class tullistes and designers at Calais get fully as much as they would at Nottingham, if not more, but in general it appears that the skilled workers at Calais average about one-fifth less than similar workers at Nottingham and the unskilled workers average much less—this in spite of the fact that food is higher priced at Calais than at Nottingham. Many of the Calais manufacturers are English or of English descent and of the higher class of workers, especially the designers, draftsmen, and quite a few of the tullistes have come from England.

VARIATIONS IN THE TRADE.

Just at present (August, 1908) the Calais industry is undergoing a period of stress due to the slackness of orders from their main customer—America—and all-night work has been stopped and even the day work has been much curtailed. During the last three or four years the Calais manufacturers have been doing a prosperous business, so that most of them are now in shape to withstand a little adversity. Fancy laces being a thing that depends entirely on the vagaries of fashion as to whether there shall be a dead loss or a tremendous profit, the manufacturers are now faced with the alternative of closing down or of running into speculation by filling their warehouses with stocks of high-priced articles, which at the turn of the market may make them either millionaires or paupers according as to how their designs take. Two or three at least of the larger houses are thus trying their luck, but the great majority are running as few machines as they possibly can without disorganizing their force and losing valuable workmen.

In spite of the huge profits in the lace industry in good years the fact that it is an industry in which there has to be continual changing to catch every passing whim of the popular fancy makes it difficult to transplant, for to conduct the business successfully takes men long skilled in the art of anticipating what the world of fashion will require in one of its main luxuries. Fancy lace making is, however, getting a good start in America, where curtain manufacturing is already firmly established, and in time the United States will certainly save for her own workers the millions that are now annually sent across the Atlantic.

Mr. Henon, one of the largest manufacturers of Calais, vouched for the fact that many of his tullistes were making hundreds of francs a week during the flush times, and that he has one man who at that time was making 2,000 francs a week. Now, 2,000 francs a week is $1,544 a month, and it would seem that any industry that can afford to pay such wages to a machine runner—even to an exceptional man in an exceptional time—is one that can be successfully organized in the United States. The first cost of the American enterprise, of course, will be higher than the first cost of a similar French enterprise, part of which would be incurred for customs duty on lace machines imported. This expense, however, would be modified or entirely removed by building lace machines in the United States.

LACE MACHINE AND LACE FACTORY.

DIFFERENT TYPES OF MECHANISMS—SPECIALLY PLANNED MILL BUILDINGS ARE NEEDED.

The lace machine is one of the most complicated and delicately adjusted machines made and is ranked among the highest if not absolutely the highest triumph of the mechanical genius of man.

Lace machines may be classed under four heads, (1) the band circular or plain net machine, (2) the lace curtain machine, (3) the warp lace machine, and (4) the Levers machine. The latter includes the "Levers machine," properly so called, with lean bars, and the "Levers go through" without lean bars, the latter being a more recent improvement and one that enables the machine to be run faster and to give a larger production, except for very complicated work. The lace machines in use at Calais are mainly of the last type. The standard machines are considered to be those of John Jardine of Nottingham and Jules Quillet of Calais. The present price of the 172 inch, 12 point Quillet, is given as 33,000 francs (franc=19.3 cents).

The lace machine is complex, but the basic principle underlying its operation is much simpler than it would appear to be on first sight. The weft threads are wound on round flat bobbins which are placed in thin steel shuttles or chariots and these swing back and forth through a vertical warp like the pendulums of clocks, each being guided by a groove. The vertical warp threads, which run up between the thin shuttles, are controlled by bars from a Jacquard and are pulled first to one side and then to the other of the straight-swinging shuttles and their crossings, which are made alternately around weft threads to their right and left with the warp threads on their right and left, and are pushed up into place by means of the needles of point bars. If the warp threads make their crossings alternately with those on their right and left it can be seen that there will be formed net work. To carry out this simple principle and to introduce variations much skillfully designed machinery is necessary.

NARROW LACE MAKING.

In figure 9 is given a front and side section of the ordinary lace machine as used to make the narrow Calais laces. In this sketch is shown sufficient details to give a corrcet idea of the method of operation.

The warp threads represented by *a* and *a'*, shown wound on small warp beams A and A' placed under the machine, pass up through the holes in a perforated guide board LL, through various pierced Jacquard bars represented by KK, and then up to the lace beam D on which the finished lace is taken up as made by means of an automatically operated ratchet wheel. The weft is shown passing from the bobbin *c* in the chariot B up to the point where the lace is formed by the twists made by the weft swinging back and forth through

the shifting mazes of the vertical warp. M and N represent the swinging rows of "points," one for each mesh in the length of the machine, that push up into place the meshes as formed. H and H′

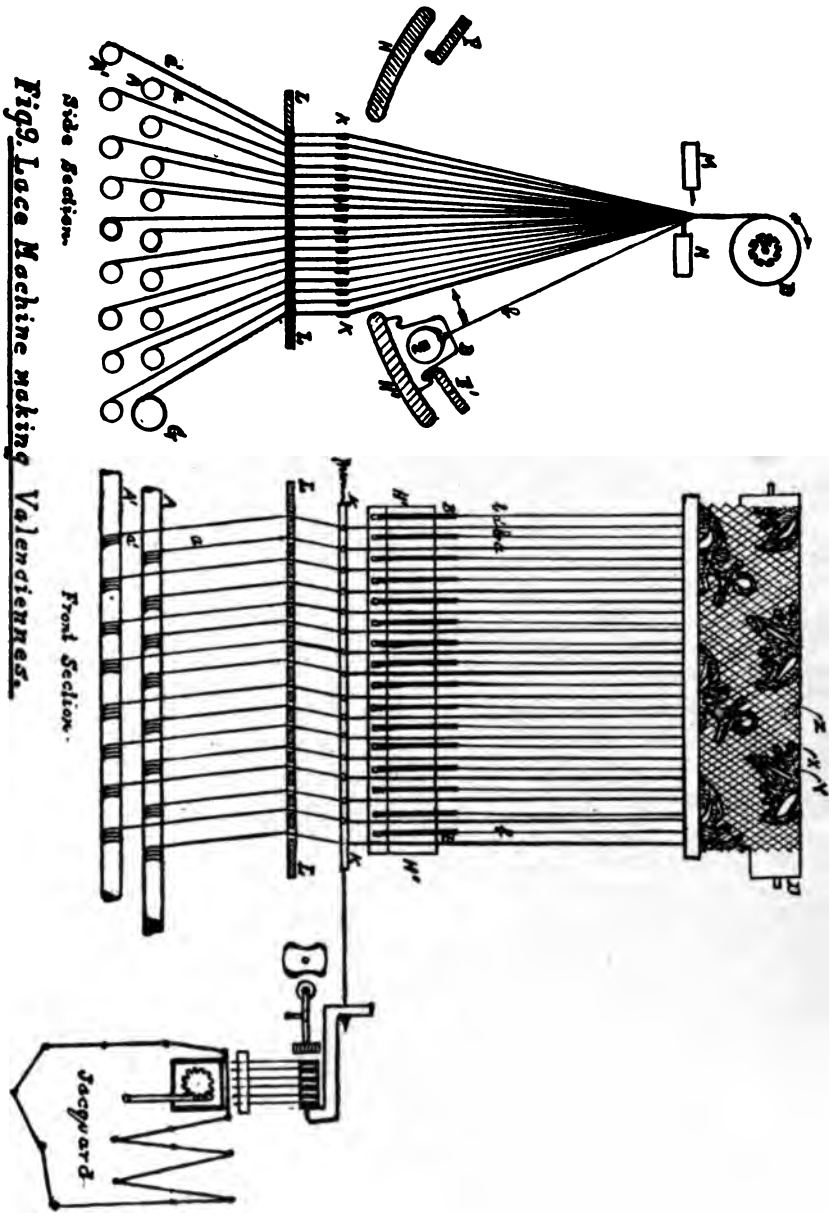

Fig. 9. Lace Machine making Valenciennes.

represent the two long comb bars, one in front and one in rear, that are grooved to receive the thin steel chariots. In lace machines proper these are stationary, while in net machines they can be shifted to one side or the other as desired. The distance between the two

comb bars is usually only 1½ inches, as it has to be such that the chariot enters the groove on one side before leaving that on the other but in the figure as sketched this space is drawn wider so as to better illustrate the arrangement of the warp. F and F′ represent the swinging catch bars which alternately draw the chariot to the front or rear and then releases as the other catch bar takes hold to draw the chariot through the warp on its return trip. Large roller G carries the ground warp, the outline and guimp warp threads being carried by the small rollers A and A′. In the finished lace, as shown on the lace beam, the ground threads are represented by Z, the "brodeurs" or threads that outline the patterns are shown by X, and the guimp threads that are used to fill in the patterns so drawn are shown by Y.

OPERATION OF BARS.

It is seen that ordinarily in a piece of Calais lace there are four kinds of threads—the weft or bobbin threads, the ground warp threads, the outline threads, and the guimp threads. Each thread in each of the three warps has to be controlled by a separate pierced bar from the Jacquard unless in its work in the strip of lace it exactly duplicates the work of some other thread. For the ground warp using two threads to the mesh there will be a repeat every four threads so that there is needed only four bars. For some varieties there are used eight ground bars. According as there are two or four threads to the mesh there will be 7,200 or 14,400 ground threads for the 12 point, 150-inch machine. For the outline and guimp threads there is usually required a bar for each. To make tulle or to obtain particular ground effects the warp has to be passed through fine bars which are themselves placed in stump bars so that each system works independently of the other.

The Jacquard bars, shown at KK in figure 1, are crowded very close together and are made of very thin steel, there being sometimes over 100 to an inch. They are pierced at intervals for the passage of the thread. In a machine making 150 strips of lace at a time a guimp bar will have 150 holes, as the same thread will do the same work in each strip. The sketch shows something of the method of control by the Jacquard at the right-hand end of the machine, each bar being attached to the Jacquard at one end and to a spring at the other. The adaptation of the Jacquard thus used is known as the Martyn spring Jacquard, and usually there is employed a small Jacquard for the top bars and a separate double Jacquard for the bottom or ground bars. The droppers operate according to the design of the holes punched in the Jacquard cards, moving each pierced bar and its attached warp thread to the right or left as the design requires, but its action being similar to that of an ordinary loom Jacquard it is not necessary to amplify this. The ground threads are only moved a short distance and the outline threads themselves rarely go over ten gaits from their normal position, a "gait" being the distance between two parallel bobbin threads.

LARGE NUMBER OF THREADS.

In regard to the number of threads employed at one time on a lace machine this may vary considerably, but is usually between 12,000 and 30,000. In a strip of lace 12 centimeters wide being

made on a 12-point, 150-inch machine, the least number of threads that could be used would be: Bobbin threads 144, ground warp threads 288, outline threads 45, guimp threads 45, a total of 522 for each strip of lace. As there would be 30 bands (150 inches is 3.75 meters) there would be a total of 15,660 threads. Some complicated designs take up to 25,000 or 30,000 threads. In the foregoing design there would be needed 4 bars for the ground, 45 bars for the outline threads, and 45 for the guimp threads, or 94 bars altogether. The number of bars in very fancy designs will run as high as 250.

As shown in the front section of figure 1 the bobbins slide in grooves cut in the comb bars, the distance sidewise from center to center of neighboring bobbins being known as a "gait." A "plomb de combs," as it is called in French, or set of combs, is the number of grooves and hence of bobbins in a space of 2 inches. This basis of measurement originally comes from the knitting machine, which was the progenitor of the lace machine. Lace machines are designated by "points," which now refer to the bobbins instead of the point bars, and by "point" is meant one-half the number of bobbins to the inch, or one-fourth the number of bobbins to the basic measurement of 2 inches. In a 12-point machine, therefore, there are 24 bobbins to the inch, or 48 bobbins to the "plomb de comb." In a 160-inch machine, 12 point, there will be 3,840 separate chariots with their bobbins swinging back and forth together in an unbroken line. Machines are usually made 9, 9½, 10, 12, 14, 15, or 16 point, but some run as coarse as 5 point and some as fine as 18 point. In the latter case there will be 36 shuttles in every inch of width of the machine, which may be 180 or more inches long, so it is seen that there has to be very nice adjustments, precision in form and finish of the gearing, and perfect solidity and rigidity of framework, so that the thousands of combs, points, guides, pierced guide bars, carriages and bobbins, etc., may work in exact harmony with each other and in obedience to the pattern laid on the Jacquard. The lace machine is also designated by gage which is the number of chariots contained in 2 inches. A lace machine of 12 points, therefore, has at the same time a gage of 48, the 16 point has a gage of 64, etc.

CONSTRUCTION OF BUILDINGS.

The Calais lace factories offer certain peculiarities worthy of note. Lace making being an art in which the operator requires perfect light, the factories are usually built around an open quadrangle in the middle. Good light and air is insured by large bays opening on both the outside and on the quadrangle.

The buildings are mostly four stories high and the lace machines are usually on the second and third floors, the first and fourth floors being used for the preparation rooms and the bureau. The rooms for repairing, folding, finishing, the sales room, storage and shipping room, bookkeeping office, etc., are collectively termed by the manufacturers the "bureau." The designing, drafting, and card-punching rooms are usually on the second floor, but separated from the machine rooms.

Access to the different floors is from the quadrangle by means of spiral iron staircases in turrets. These turrets communicate at each

floor with iron balconies on which open the doors of the different workrooms. There are usually no interior staircases and the isolation of the different workrooms is thus complete, which is not only a source of safety in case of fire, but also tends to confine the secret of the operations in each room to the particular workers there employed, and thus prevent details of new designs leaking out to be made use of by their rivals.

The engine and boiler rooms are in a separate structure placed in the center of the quadrangle. Rope driving is universal. Electric driving is as yet very rare and it is only recently that electric lighting has come into general use. Heating is by means of flanged steam pipes placed along the wall near the floor.

All the large manufacturers have their own buildings. In many other cases the owner of the building rents the premises to one or more manufacturers and sometimes contracts also to furnish power, heat, and light. In some of these large factory buildings there will be as many as a dozen small manufacturers each operating a few machines or else confining himself to some specialty, such as spooling and warping, etc. Small manufacturers find it cheaper to rent the required space in a large factory building where they can get their needs supplied close at hand than to put up separate smaller buildings of their own. The figures furnished me by the manufacturers association for March 1, 1908, showed 584 manufacturers for 2,615 machines. It is apparent that while some of these are engaged on special lines of manufacture there must be a large number of small manufacturers owning one to ten machines.

FOUR DEPARTMENTS—IMPORTANCE OF DESIGNING.

There are four divisions of the operation of the lace factory, (1) the designing, (2) the preparation of the materials, (3) the lace making, and (4) the finishing and cutting out.

The designing is the most important part of lace making, for without a good design lace is useless rubbish, as it will be unsalable. The designer is therefore the mainstay of the establishment and on him depends in large measure the success or failure of the firm. The designer usually gets the highest salary and is engaged by the year, and frequently is under contract for five years or more. The large factories have their own designers, while the smaller ones very often obtain their designs from outside professional designers. Public designers sell ordinary designs at the rate of 1 franc per centimeter of width, thus a design 10 centimeters in width sells for 10 francs, etc., though fancy designs bring fancy prices. The designer should be a practical worker, but this is not always the case, for his work being more artistic than mechanical designs are often sketched out that the factory is not able to fabricate at all or else not at a cost that will afford them a profit.

Sometimes a designer will work for a year on one design. The designers have to be continually on the alert to satisfy the fanciful demands of the mode. Sometimes very light articles are in favor and at other times coarse articles, sometimes one special style and sometimes another; hence the designer has to keep in touch with the market requirements in order not to load the shelves of his factory with unsalable articles. The great races at Longchamps and Auteuil in

the spring are the places where the designers get their first idea, from the costumes there worn by the Paris women, as to what is going to be the prevailing mode of the season. The designer forms his opinion and essays to create a new design along the lines of those in vogue or to make modifications of what he has seen.

MAKING DESIGNS.

The designer sketches the broad features of a design, floral, geometrical, or a combination of the two, but the smoothness of outline of such sketches can not always be reproduced, as the pattern will have to be displayed on a network of meshes. The sketch as made by the designer has to be transferred to cross-section paper by a draftsman and drawn to scale so that the width is proportioned to the number of chariots to be used and the length to the number of Jacquard cards employed. Briefly to illustrate: Suppose there is a sketch for a Valenciennes lace 12 centimeters wide and the sketch repeats every 7 centimeters, and it is decided to make it on a 12-point machine. A 12-point machine has 24 chariots to the inch, and as 12 centimeters is 4.72 inches this requires 112 chariots for each strip. In showing this on the cross-section paper there is usually employed one-fourth as many spaces as chariots, so for example a width of 28 squares will be taken. For the length of this foregoing design a rack of 1,920 motions will make 70 centimeters of lace; hence for the 7 centimeters of the repeat there will be required 192 motions. It is customary to use one-sixteenth as many vertical squares as there are motions, so there will be 12 vertical squares. The design will therefore be reproduced on paper showing 28 by 12, or 336 squares.

Sometimes the designer and the draftsman who puts the design on cross-section paper are one and the same, but it is preferable to have separate men to secure the best results. On the cross-section paper the draftsman shows in different colored ink the positions of all the threads and their interlacings, and this is a work that requires long years of study and an accurate knowledge of the capabilities of the machine. In complicated designs made with independent bars such representation is difficult, and often two or more sketches have to be shown to convey the idea accurately.

The design thus completed on cross-section paper is handed over to a woman called a "pointer," who traces the course of each thread and marks its position by means of numbers on similar cross-section paper. While this is not very skilled work, it requires great accuracy. These sheets with numbers go to the puncher, who sits at the piano puncher and punches the cards according to the figured position of the different warp threads as shown on the point paper before him, punching one card for each line of squares on the paper corresponding to one movement of the machine. The point paper marked with the figured position of the warp threads is usually called the "bareme." The cards after punching are laced together, sometimes by machine, but oftener at Calais by hand, and are then ready for use on the jacquard.

PREPARATION OF THE YARN.

Going from the designing department to the preparation departments, the yarn is usually bought in skeins, though sometimes on the cop and occasionally on cones. Part of the yarn comes from England and part from France, the latter mainly from the fine spinning mills of Lille. In ordering both the French and English numbers are usually given so as to prevent mistake. Thus if there was required 1,000 kilos (kilo=2.2 pounds) of two-ply No. 100 English there would be ordered "1,000 kilos of No. 100/85/2 cotton yarn," which would be clear, as the corresponding French number is always less than the English number.

In the preparation rooms will be found spoolers, warpers, wheelers, and perhaps twisters, cone winders, and gassing frames. The first operation is usually spooling. The weft threads are then run onto beams about 12 inches wide and 20 inches diameter. These beams then go to a machine usually called a "wheeler;" the girl operating same is called in French a "wheeleuse." This machine is used for filling the thin bobbins with thread. The bobbins are slid on a square arbor, usually 60 to 80 at a time, and each separate thread guided into the groove of a bobbin. An indicator marks the length of yarn wound on, which varies according to the size of the bobbin and the fineness of the yarn, but usually about 35 meters, corresponding to, say, three strips of lace as made by movements measuring 80 to 100 racks. The wheeleuse is paid usually about 5 centimes per 100 bobbins filled, and will make from 2 to 5 francs a day, according to skill. Another machine using a square arbor is used to unwind from the bobbins as brought back from the machine the short lengths of thread that remain on them. These are unwound onto ordinary spindle bobbins, and a small boy operates 6 or 8 of such spindles, making 1.5 to 2.5 francs a day. The warp threads after spooling are creeled, and those to be used for the outline and guimp threads are wound directly onto small warp beams, which are about 1.5 inches diameter and in length either the half or the full length of the lace machine. As the ground warp is not so divided, but is on one beam which may have from 7,000 to 15,000 threads, this can not be run on from one creel, but creel after creel is run on side by side onto the swift of a large mill, and then all the warp threads thus run on are run off together onto the large warp beam, which then goes to the lace machine.

INSPECTION AND FINISHING.

After the lace is made it is inspected and repaired, bleached or dyed, starched, clipped, the strips cut apart, then again inspected and repaired, measured, folded, ticketed and put up for shipment.

The lace is inspected and repaired in the factory, but the bleaching, dyeing, and starching are carried out in separate establishments. After bleaching and starching the lace is put on the pins of a tentering machine, and as it moves forward through a drying chamber the sides holding the lace are moved back and forth in opposite directions so as to draw out the meshes to their full width. Instead of a tentering machine a stationary tenter is usually used for fine laces and the lace left stretched in a heated room with fans blowing over it until well dried.

The lace then goes back to the factory. The next process is clipping, which may be done in the factory, but is usually outside work. For articles in which the floats occur in regular straight lines the material is put on the table, and as it is drawn forward by rollers the operative holds a pronged clipping knife flat on the line of floats, which does the work very quickly. Usually, however, the nature of the design is such that the floats can only be removed by regular scissor work, and this is done in the homes in the country for miles around Calais.

The period of greatest activity in the lace industry usually occurs when the farm work is inactive; thus, while the remuneration received by those who clip the threads is very small, it is a welcome addition to their income during a dull period. There are a large number of men known as "entrepreneurs de decoupage," or clipping contractors, who take quantities of the lace and distribute it throughout the villages as far off as the Belgian frontier and the country beyond Boulogne. It is a common sight to see these contractors getting on and off the train at Calais with great bundles of lace on their backs. The manufacturer pays this contractor per thousand floats, which means per 2,000 scissor cuts. The average figure is about 8 centimes (100 centimes=1 franc=19.3 cents) per thousand clips, but as the contractor must make his profit the actual home worker gets much less. After the floating threads are clipped off the strips of lace are cut apart by cutting and drawing out the threads that bind them together.

The lace is then returned to the factory by the clipping contractor and is there inspected and again repaired. It is then folded into 12-yard (11-meter) lengths, ticketed, put up in packets, and these packed in large wooden boxes. There is much variety in the methods of arranging for market according to the different desires of their customers, sometimes the lace being wrapped on cardboard, sometimes on paper of various colors, sometimes on itself, and being wrapped around with gold and silver threads, with name bands, etc. The packets of Valenciennes are usually put up to contain three 12-yard strips, but there is no fixed rule as to the other varieties.

WAGES PAID IN CALAIS.

SCHEDULE OF PAY DRAWN UP THROUGH JOINT AGREEMENT—VARIATIONS ACCORDING TO BUSINESS CONDITIONS.

The worker who operates a lace machine at Calais making tulle or lace is called a "tulliste." He is paid per "rack," and by rack is meant 1,920 picks or motions made by the bobbin and its chariot through the lines of warp threads; that is, 960 motions from front to rear and 960 motions from rear to front. The price paid per rack varies according to the kind of lace being made, according to the gage of the machine, the width of the lace strips, etc., and is usually based on the tariff of wages made up in 1890 for the different articles.

In the early part of 1890 the factory owners held a meeting to put an end to ruinous competition among themselves due to undercutting of wages by some of their members. They drew up a complicated wage tariff that was to be adopted as the minimum below which no manufacturer was to go. The workers thought that an attempt was being made to lower their wages, and immediately struck, refusing to work under any wages tariff in which they had no voice. Their claim was finally allowed, and a committee of the "Association des Fabricants de Dentelles de Calais," jointly with a committee from the "l'Union Francaise des Ouvriers Tullistes," drew up a mutually satisfactory schedule. This was adopted for one year, and at the end of that time was repudiated by the manufacturers, but the workers' associations continued to agitate for its enforcement and boycotted those who attempted to pay less, until in 1896 it was again accepted by the employers. This tariff is not always adhered to, and in flush times like 1905, 1906, and part of 1907 the actual remuneration ran very much above the schedule, but prices have now dropped back to rock bottom, and as the employees resist any attempt to cut under the schedule this tariff is at present very generally observed in Calais.

The wage tariff as made in 1890 specified 21 articles, and the revision that was made in 1906 added 9 others, giving 30 articles which practically covers the range of work.

The standard on which the tariff is based is the lace machine of 144 to 154 inches and the "rack" of 1,920 motions. For every 10 inches or fraction of 10 inches that the machine is longer or shorter than the standard given there is added or subtracted 5 centimes from the standard prices. The schedule is for work in the gray, and for all classes there is added for black work the following additions: 10 centimes more for gages under 9 point, 15 centimes more for gages 9 to 12 point, and 20 centimes more for gages above 12 point. For triple-warp work there is added to the regular schedule the following for all classes: 10 centimes for gages 9 to 10 point, 15 centimes for gages 10 to 12 point, 20 centimes for gages 12 to 14 point, and 25 centimes for gages above 14 point. "Hauteur," as

given in the wage schedule, refers to the width of the lace strips. It is given not in centimeters, but in reseaux or meshes. "Rendement," as given in the schedules, refers to the length of lace woven by a rack of 1,920 motions. This length will vary according to the size of the mesh and the class of work being made, but for each article there is chosen a certain "rendement" or standard production, on which the price is based, and then for lengths longer or shorter there is added or subtracted 5 centimes for every 15 centimeters or fraction of 15 centimeters difference from the standard selected.

The first article given in the wage tariff of 1890 is Chantilly lace, and the tulliste is recompensed as follows in francs per rack:

ARTICLE I.—*Chantilly.*

Four bars, without fine bars, double warp. Standard: 144–154 inch machine; 1,920 motion rack.

Hauteur.	9 to 10 points, inclusive.	10 per cent more up to 11 points.	20 per cent more up to 12 points.	30 per cent more up to 13 points.	40 per cent more up to 14 points.	50 per cent more up to 15 points.
30	0.65	0.71	0.78	0.85	0.91	0.97
36	.70	.77	.84	.91	.98	1.05
48	.75	.82	.90	.97	1.05	1.12
64	.80	.88	.96	1.04	1.12	1.20
80	.85	.94	1.02	1.10	1.19	1.27
96	.90	.99	1.08	1.17	1.26	1.35
104	.95	1.05	1.14	1.24	1.33	1.42
112	1.00	1.10	1.20	1.30	1.40	1.50

Under 9 point subtract 10 per cent for every point of gage. Production (rendement) of 70 centimeters to the rack taken as the standard and 5 centimes added or subtracted for every 15 centimeters or fraction thereof more or less than the standard. Compensation for length of machine different from the standard, for black on the machine, or for triple warp, as previously given.

In the foregoing it is seen that the price increases 10 per cent for every point of gage. This is the case with the first nine articles, of which the prices paid for the 9 to 10 point gage and other gages given in the next table can be figured therefrom by adding 10 per cent for every additional point. Including the Chantilly above, this table is as follows:

Hauteur.	Chantilly: 4 bars without fine bars, double warp.	Chantilly: Fine bars, stump bars, and guimps.	Plumetis or floss: 4 bars without fine bars.	Plumetis or floss: Stump bars and fine bars.	Mat chains.	Mat bobbin.	Center guimps.	Center guimps with stump bars and fine bars.	Matelasses or guimps in front and rear.
	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	No. 7.	No. 8.	No. 9.
30	0.65	0.70	0.65	0.70	0.70	0.75	0.65	0.70	0.85
36	.70	.75	.70	.75	.75	.80	.70	.75	.90
48	.75	.85	.75	.85	.85	.90	.75	.85	.95
64	.80	.90	.80	.90	.90	.95	.80	.90	1.05
80	.85	1.00	.85	1.00	1.00	1.05	.85	1.00	1.15
96	.90	1.05	.90	1.10	1.05	1.10	90	1.10	1.20
104	.95	1.10	.95	1.15	1.10	1.20	.95	1.15	1.25
112	1.00	1.15	1.00	1.20	1.15	1.20	1.00	1.20	1.25
120	1.05	1.20	1.05	1.25	1.20	1.25	1.05	1.25	1.35

For articles Nos. 1, 3, and 7 the standard production or "rendement" (called "quality" in Nottingham) is selected as 70 centimeters to the rack; for articles Nos. 2, 4, 5, 8, and 9 as 65 centimeters to the rack; and for article No. 6 as 50 centimeters to the rack, and 5 centimes is added for every 15 centimeters or fraction thereof that the production per rack exceeds the length taken as the standard for that particular article.

The tariff for other articles is as follows:

ARTICLE No. 10.—*Laizes and laizes voilettes (veilings).*

With or without borders, dots, and small figures; 4 bars without fine bars. Standard production per rack, 60 centimeters, the price being up to 16 bars.

Points.	Francs.	Points.	Francs.
9	0.40	13	0.67
10	.45	14	.75
10.5	.50	15	.82
11	.52	16	.90
12	.60		

Add 2.5 centimes more for each 5 bars or fraction of 5 bars above 16. For the same article with fine bars or with center guimps add 5 centimes more if under 11 points and 10 centimes if 11 points or above.

ARTICLE No. 11.—*Blonde-mode-voilette.*

Veilings set up with 4 bars, double warp. Maximum, 60 bars in all widths from 10 to 20 centimeters. Standard production per rack, 60 centimeters, the price being up to 20 bars.

Points.	Francs.	Points.	Francs.
9	0.50	13	0.77
10	.55	14	.85
10.5	.60	15	.92
11	.62	16	1.00
12	.70		

Add 2.5 centimes more for each 5 bars or fraction of 5 bars from 20 bars up to the maximum of 60 bars. For the same article with fine bars or with center guimps, add 5 centimes more if under 11 points, and 10 centimes more if 11 points or above.

ARTICLE No. 12.—*Chantilly.*

With independent bars, double warp. Standard production per rack, 65 centimeters.

Hauteur.	Francs.	Hauteur.	Francs.
12	0.75	24	0.80
16	.75	30	.85
20	.75		

ARTICLE No. 13.—*Article bourdon.*

Heavy bobbin, double warp. Standard production, 50 centimeters per rack.

Hauteur.	Francs.	Hauteur.	Francs.
30	1.15	64	1.25
36	1.15	80	1.30
48	1.20	96	1.40

ARTICLE No. 14.—*Large ground articles.*

	Centimes.
Plain ground	40
Plain ground with spots or lozenges	50
Plain ground with larger designs	60

ARTICLE No. 15.—*Silk articles, single warp.*

Four bars without fine bars. Standard production per rack, 85 centimeters.

Hauteur.	Centimes.	Hauteur.	Centimes.
24	50	48	60
30	55	64	65
36	60		

ARTICLE No. 16.—*Woolens.*

With independent bars.

Hauteur.	9½ points.	9¾ points.	9¾ points.	10 points.
36	0.60	0 80	0.85	0.90
48	.65	.85	.90	.95
60	.70	.90	.95	1.00
72	.75	.95	1.00	1.05
96	.80	1.00	1.05	1.10

Standard production per rack taken as 100 centimeters and 5 centimes added for every 15 centimeters more than the standard.

ARTICLE No. 17.—*Carres, filets, neuvilles, and points de Paris.*

With independent warp and bars.

Points.	Centimes.	Points.	Centimes.
9 to 10, inclusive	40	11 to 12, inclusive	50
10 to 11, inclusive	45	Above 12	55

ARTICLE No. 18.—*Guipure, cluny, and similar.*

With independent bars. Standard in this case taken as double rack of 3,840 motions. The rate includes up to 80 bars for large rack.

Points.	Centimes.	Points.	Centimes.
9 to 10, inclusive	90	11 to 12, inclusive	110
10 to 11, inclusive	100	Above 12	120

ARTICLE No. 19.—*Valenciennes.*

Standard in this case taken as double rack of 3,840 motions.

Bars.	9 to 10 points.	10 to 11 points.	11 to 12 points.
Up to 40	0.80	0.85	0.90
From 40 to 60	.85	.90	.95
From 60 to 80	.90	.95	1.00
From 80 to 100	.95	1.00	1.05
From 100 to 120	1.00	1.05	1.10
From 120 to 140	1.05	1.10	1.15
From 140 to 160	1.10	1.15	1.20
From 160 to 180	1.15	1.20	1.25
From 180 to 200	1.20	1.25	1.30

Add 5 centimes more for each additional point of gage.

ARTICLE No. 20.—*Plain platts.*

With fine bars. Standard in this case taken as double rack of 3,840 motions. Rate per large rack.

Points.	Centimes.	Points.	Centimes.
Up to 9¾	80	12 to 13	110
9¾ to 11	90	13 to 14	120
11 to 12	100	14 to 15	130

Article No. 20 bis.—Platts with embroidery, add 5 centimes more per 10 bars or fraction of 10 bars.

ARTICLE No. 21.—*Cotton loop ground.*

Single warp. Regular standard of 1,920 motions to the rack. Up to 40 bars pay 50 centimes a rack and add 5 centimes for each 20 bars or fraction of 20 bars above 40 bars. Standard production per rack taken as 75 centimeters. For double warp add 5 centimes and for triple warp 10 centimes per rack.

CHANGING.

A day of changing is to be recompensed with 4 francs per ten hours. An entire week of changing will be paid for by 25 francs. There will be considered as changing: (1) Setting up the machine; (2) changing the material on a machine, even partially; (3) trying a new design that takes more than a day to get in full operation; (4) changing the article.

When the worker who makes the alterations gains 30 francs in the week, the changing price will not be paid him. For example: (1) when a worker has made three days of alteration work at 4 francs, which is 12 francs, and has also made 15 francs by the rack, which will be 27 francs total, that will be his week's salary; (2) when worker has made three days of alteration at 4 francs, or 12 francs, and has made 22 francs by the rack, or a total of 34 francs, his week's wages will be only the 30 francs.

All alterations which do not last a day will not be paid for unless the worker has not been furnished with machine work by the rack before the alteration work. All alterations which will be made by a worker on a machine other than his own, however, will be paid according to the amount that he would have earned on his own machine.

For working up a warp of less than 50-hank lengths, the worker will be paid additional: 10 centimes up to 10-point gage, 15 centimes for 10 to 12 point, and 20 centimes above 12-point gage.

GENERAL CONSIDERATIONS.

First, selvage bars, stump bars, etc., will not be counted as bars employed.

Second, as for the "volants et barbes" (embroidered places on the raised figures) they will be paid for as follows: 5 centimes more to the rack for simple work, 10 centimes

more to the rack for large threads and fine bar work, 15 centimes more to the rack for more complicated work, and 20 centimes per rack for the difficult work.

Third, for "laizes" (widths) fabricated with the same mounting as for the bands the price will be the same.

Fourth, cotton articles of which the mounting is the same as for silk articles (such as Alencon, Bretonnes, Bischop, etc.) will be paid for at the same rate as for the silk articles.

Fifth, for articles which do not appear in the present tariff the remuneration may be such as mutually agreed on by employers and employees.

Sixth, for articles using gold, silk, or other metal threads the additions to be made to the regular tariff shall be as mutually agreed on for each case.

Seventh, lighting, heating, and oiling shall be at the charge of the employer.

Eighth, the standard of length of the machine, 144 to 154 inches, shall be taken as the tariff basis for all articles.

Ninth, the week commences Monday morning at 8 o'clock and finishes Saturday evening at 6 o'clock.

Tenth, for the application of the present tariff and for the settlement of disputes there shall be a commission of six members, of which three shall be employers and three employees, these to be taken from their respective associations.

The foregoing tariff for 21 articles was agreed to in 1890 and is still in force. In 1906 there was added the following articles:

ARTICLE 22.—*Various articles with heavy border threads using gages under point 9.*

	Hauteur.	Up to 6 bars.	6 to 12 bars.	12 to 18 bars.	18 to 24 bars.
Mixed bourdon	72	0.95	1.00	1.05	1.10
	96	1.00	1.05	1.10	1.15
	120	1.05	1.10	1.15	1.20
	144	1.10	1.15	1.20	1.30
Plain bourdon and entre-deux	72	1.05	1.10	1.15	1.20
	96	1.10	1.15	1.20	1.25
	120	1.15	1.20	1.25	1.30
	144	1.20	1.25	1.30	1.35

Add 5 centimes more for each 6 bars or fraction of 6 bars of bourdon. The fine bars fix the width. Standard production taken as 1.20 meters per rack and 5 centimes are added for each 15 centimeters or fraction thereof up to 1.5 meters; over 1.5 meters add 10 centimes for each 15 centimeters or fraction thereof.

Add 5 centimes for each half point of gage above 5 point. Add 5 centimes for center guimps. For center guimps and triple warp add 5 centimes for gages up to 5 point, 7½ centimes for gages 5 to 6 point, and 10 centimes for gages 6 to 7 point.

ARTICLE 23.—*Veilings called armure.*

Standard production taken as 50 to 80 centimeters per rack. Plain gages:

Up to 8½ points	0.30
9 to 10 points	.35
10 to 11 points	.385
11 to 12 points	.42
12 to 13 points	.455
13 to 14 points	.39
14 to 15 points	.525

For reduced gages: Add 5 centimes for each half gage from 16 to 10 points, and same from 9 points under. For 3 chariots inside and 1 out pay as for plain gages. For 2 chariots in and 1 out, the same. For 1 chariot in and 3 out pay ½ gage. Standard production taken as 80 centimeters for reduced gages and 2.5 centimes added for each 30 centimeters; below 50 centimeters subtract 2.5 centimes for each 30 centimeters less.

"Mouches" with the warp: Mouches of 4 gaits or less add 2.5 centimes. Mouches of 6 gates add 2 centimes, of 8 gaits 2.5 centimes, more taken on the plain gage supplement for the mouches as for 2 and 3 gaits.

Bars: For 8 bars or fraction of 8 bars up to 16 bars working with the warp, 2 centimes more. Bars working with heavy thread, separating, or for selvage do not count as additional. For "friquettes" embroidered with independent bars, apply article 10 of the tariff.

Length of machine: Machines above or below the standard of 144/154 inches will be paid more or less in proportion to their length. For a reduction under 120 inches for ¼ the supplementary warp add 5 centimes, for ½ warp add 10 centimes.

ARTICLE 24.—*Large ground.*

Additional: To add to article 14 the lozenges more than 2 centimeters in diameter pay 60 centimes. One-half warp supplementary 10 centimes more per half gage. Entire warp supplementary ½ gage 10 centimes more

ARTICLE 25.—*Imitation Valenciennes, double warp.*

For center guimps apply article 8. For guimps in center and rear apply article 9. Reductions: One-half warp 10 centimes less up to 10 points inclusive. Fifteen centimes less from 10 to 15 points.

ARTICLE 26.—*Heavy cotton bobbin, flat kind with coarse border thread.*

Apply article 6 of the tariff. The article 20 bis (platt with embroidery) say from 1 to 10 outline or border threads only to start from the hauteur 36.

ARTICLE 27.—*Mouches made with iron yarn.*

Friquettes laizes ½ gage, with four rolls for ¼ warp, covering silk in gray, bleached, and black. These articles have no tariff but are by agreement.

ARTICLE 28.—*Cluny and similar.*

Coarse guipure, independent bars with or without repetition. Standard production taken as 50 centimeters; 55 centimes up to 60 bars; 5 centimes more for each fraction of 10 bars additional; 5 centimes more for each 10 centimeters more of production.

ARTICLE 29.—*Supplementary to article 29 of the tariff.*

The standard of production of the Valenciennes will be 40 centimeters per rack of 1,920 motions. Add 5 centimes for each fraction of 10 centimeters above the standard up to 80 centimeters; 10 centimeters more for each fraction of 10 centimeters above 80 centimeters.

ARTICLE 30.—*Torchon guipure with independent bars.*

Standard production taken as 60 centimeters, using 60 bars. For every 20 bars or fraction thereof additional add 5 centimes. For every 15 centimeters or fraction thereof of production additional add 5 centimes.

SUMMARY OF WAGES.

In the tariff the actual wages received by the tulliste works out as follows: Take a piece of 10-point Chantilly lace of 64-mesh width. The remuneration is 80 centimes a rack and the machine will get off about 240 racks a week working 20 hours a day with two shifts. This would be 192 francs to be divided between the two tullistes or about $18.50 a week each. On a 10-point Valenciennes 100 to 120 bars the rack is remunerated for at one franc. There may be gotten off 300 racks on this, so there will be 300 racks to be divided between the tullistes, which would be $29 to each for their week's work.

It is seen that on the latter the pay per rack is higher, and it happens in this particular case that it is an article on which more racks can be made on, but the work is more difficult and it requires a much more skillful tulliste, so that the remuneration depends on the skill of the worker, and only the best workers are given the finer and higher paying articles.

The foregoing examples are for a week of steady work with the article unchanged. Ordinarily there is much time lost by reason of setting up and changing designs and other causes, so that the ordi-

nary wages of a good tulliste will probably not average much over 50 francs or $10 a week. In exceptional times on very fine work this average may run up into the hundreds of francs, and as previously noted, one tulliste employed by Mr. Henon has made the record earnings of 2,000 francs a week.

The tulliste is the best paid of the operatives with the exception of the designer and the manager. The bobbin and clippers are also paid by the piece, while the majority of the other hands are employed in lace work by the day or week and the office force by the month. The "wheeleuse," or girls who fill the bobbins, are paid usually 5 centimes a hundred bobbins.

As previously noted the clipping is usually taken by contractors who let it out to home workers. The contractor is paid 8 centimes per 1,000 floats cut which calls for 2,000 clips of the scissors and the home worker gets about 6 centimes out of this. Cutting and pulling out the threads that hold together the different strips of lace is paid for usually at the rate of one franc per 100 meters of lace. The home workers only make from 15 to 40 cents a day.

The wages received by the workers in an average Calais lace factory will average about as follows per week:

	Francs.	Dollars.
Designer (first class)	100 to 300	19.30 to 57.90
Draftsman	75 to 200	14.50 to 38.50
Woman pointer	40 to 80	7.75 to 15.50
Card puncher	50	9.65
Card lacer	20	3.86
Warper on ground warps	50	9.65
Warper on small rolls for guimps, etc	30	5.79
Wheeleuse (bobbin filler)	35	6.75
"Remonteur," setting up design on machine	20	3.86
Mender	25	4.83
Folding, ticketing, etc	18	3.47

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60TH CONGRESS } HOUSE OF REPRESENTATIVES { DOCUMENT
2d Session } { No. 1353

GERMAN IRON AND STEEL INDUSTRY

By

CHARLES M. PEPPER

Special Agent of the Department of Commerce and Labor

AND

A. M. THACKARA

American Consul-General at Berlin

TRANSMITTED TO CONGRESS IN COMPLIANCE WITH THE ACT OF MAY 22, 1908, AUTHORIZING INVESTIGATIONS OF TRADE CONDITIONS ABROAD

JANUARY 20, 1909

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DEPARTMENT OF COMMERCE AND LABOR,
OFFICE OF THE SECRETARY,
Washington, January 20, 1909.

SIR: In compliance with the act making appropriations for the legislative, executive, and judicial expenses of the Government for the fiscal year ending June 30, 1909, approved May 22, 1908, I have the honor to transmit herewith the report of Special Agent Charles M. Pepper on the German Iron and Steel Industry, together with a report from the American consul-general at Berlin on the same subject.

Respectfully, OSCAR S. STRAUS,
Secretary.

The SPEAKER OF THE HOUSE OF REPRESENTATIVES.

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LETTER OF SUBMITTAL.

DEPARTMENT OF COMMERCE AND LABOR,
BUREAU OF MANUFACTURES,
Washington, January 7, 1909.

SIR: I have the honor to submit herewith special reports on the German iron and steel industry.

The growing importance of the iron and steel industry in the United States is evident from the fact that its output has increased in value from $207,000,000 in 1870 to over one billion dollars annually at the present time, the number of wage-earners also advancing from 77,000 to 250,000. Other industries and enterprises dependent on this basic manufacture are multitudinous.

The next country in rank in this industry is Germany, which has likewise shown great activity in its extension, especially for the export trade. The German Empire sold abroad in 1907 over $178,000,000 of iron and steel products, or only about $19,000,000 less than the export trade of the United States in such productions, including machinery. The investigation of this German field of activity is therefore interesting in its international bearing, and this monograph prepared by Special Agent Pepper, supplemented with a report from Consul-General Thackara, is therefore timely.

Respectfully,

JOHN M. CARSON,
Chief of Bureau.

To HON. OSCAR S. STRAUS,
Secretary of Commerce and Labor.

H D—60-2—Vol 95——32

GERMAN IRON AND STEEL INDUSTRY.[a]

By Charles M. Pepper,
Special Agent of the Department of Commerce and Labor.

INTRODUCTION.

The German iron and steel industry is the growth of the last quarter of a century. Within that period Germany has distanced Great Britain and has become second only to the United States in raw iron production. In 1885 the production in Great Britain was 7,534,000, in the United States 4,109,000, and in Germany 3,687,000 metric tons. By the end of 1907 the relative position of the three countries which together produced 81 per cent of the world's raw iron was: United States 26,194,000; Germany 13,046,000, and Great Britain 10,083,000 metric tons.

In the conversion of raw iron, that is, in making steel, the change has been even more momentous. In 1900, when Germany passed Great Britain, the figures of steel production were: United States 10,382,000, Germany 6,646,000, Great Britain 5,131,000 metric tons. In 1907 the steel production of these three countries, comprising approximately 80 per cent of the world's total, stood: United States 23,733,000, Germany 12,064,000, and Great Britain 6,627,000 metric tons.

The periods of progressive growth during the last twenty-five years have not been uninterrupted. A partial paralysis was the penalty of the extraordinary activity of 1900, and the rapid expansion which followed the recovery from that depression culminated [illegible] be succeeded by sharply curtailed demand, de[illegible] universal uncertainty in 1908. The year [illegible] improvement, and the means by which th[illegible] will put German industrial and commercia[illegible] Yet in the light of past results the future [illegible]

[a] In all cases, unless otherwise stated, me[illegible] statistics quoted are from German sources. I[illegible] currency the value of the mark is placed a[illegible]

The development of the German industry from the production of raw iron to the transformation of steel into finished articles has some remarkable economic features. In business organization and commercial methods, in the syndication of the products, in transportation, in the relative proportions sought between domestic consumption and exports abroad, a consistent policy is maintained throughout. As the outcome of this consistent policy, Germany continues a constant factor in the world's markets notwithstanding the new and changing conditions of production and distribution.

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Some of the sources from which statistical and other information are drawn upon in this report are indicated below:

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RAW MATERIALS.

In the upbuilding of the industry natural disadvantages of production and of assembling the raw material had to be overcome, there not being any one convenient point for the ore and the fuel to meet. Both native deposits and foreign importations of fuel and ore are drawn upon—fuel in a minor degree—the native sources being substantially sufficient though not always geographically convenient. The mineral coal production of the German Empire in 1887 was 60,334,000 tons; in 1900, 109,920,000 tons; in 1907, 143,168,000 tons. The chief centers of coal production of the Empire are in widely separated sections of Prussia, Silesia in the east and the Westphalian-Rhenish provinces in the west. Some coal is produced in the Prussian province of Saxony. The kingdom of Bavaria and the imperial territory of Alsace-Lorraine contribute a quota. However, the product of Bavaria and the other States is available only for household consumption and for local industries. Of the 143,168,000 tons mined in 1907, the total for Prussia was 134,044,000 tons. This fixes the relation of the Prussian Kingdom to the industry. In addition to the stone or mineral coal, brown coal or lignite to the amount of 52,660,597 tons was produced in the different districts of the Empire, but this does not enter largely into the consumption for industrial purposes. Silesia produced 37,803,000 tons out of the total of 134,000,000 tons mined in Prussia.

PRODUCTION IN RHENISH PROVINCES—FOREIGN FUEL AND ORES.

The center of production in western Prussia, or the Rhenish-Westphalian provinces, is in the Ruhr district. The coal basin takes its name from the River Ruhr, which is a tributary of the Rhine. The Aix-la-Chapelle, or Aachen, district, which produces some coal, adjoins it. The Ruhr deposits, however, are the commercially valuable ones, though they have to be worked 2,000 feet underground. Coke from the coal thus obtained is not of the best quality. Such as it is, it furnishes the fuel for the blast furnaces and foundries and is the basis of the iron and steel industry there.

While the native coal fields are the main source of fuel supply for the blast furnaces and rolling mills, they are not entirely dependent on it, and some flourishing industries have grown up along the North Sea and Baltic coasts which obtain their fuel as well as their ores from abroad. The imports of mineral coal in 1907 were 13,721,549

tons, of which the United Kingdom supplied 11,952,383 tons, the remainder coming from Belgium, Holland, and Austria-Hungary. The exports for the same year were 20,056,503 tons, Austria-Hungary taking 8,459,226 tons. After that were Holland, 4,342,305 tons; Belgium, 3,069,594 tons; Switzerland, 1,584,768 tons; France, 1,324,903 tons; and Russia, 836,295 tons. The excess of exports over imports, it will be observed, was 6,300,000 tons, a situation which caused great complaint by the domestic industries.

The imports of coke in 1907 were 584,220 tons, while the exports were 3,793,073 tons. This excess of coke exports over imports is to be considered in connection with the production and importation of coal. Otherwise the relation of the coal industry to the other native industries, and the ability of the native mines to supply all that might be needed, would not be fully understood. It is also to be noted that both the coal and the coke exports are almost entirely to adjoining Continental countries, while the bulk of the coal imports are from overseas—that is, from the United Kingdom. Further scrutiny of the statistics shows that the imports from the United Kingdom are largely dependent on water transportation. Inland industries which are situated contiguous to the rivers and the canals may utilize English coal, but where it has to be transferred to railway cars the expense is too great except in unusual circumstances. As regards the inland blast furnaces and rolling mills, while the majority of them are located near the Rhine and other water courses, they do not depend on the British coal, because the native supply is more convenient.

RELATION OF COAL SUPPLY.

The relation of the coal supply to the iron and steel industries is made clear from a summary of the quantities and percentages employed. In one year, 1904, the iron blast furnaces and foundries consumed 22,371,000 tons. This included the quantities consumed by the companies which controlled their own collieries, the total of which was estimated at 9,940,000 tons. In the same year the iron and finishing trades consumed 3,962,025 tons, or 7.71 per cent of the production. The estimate was that in 1905 the blast furnaces and foundries consumed 28.32 per cent of the output of the Ruhr basin, and in 1906, 30.37 per cent. In 1906 in addition to the consumption by the blast furnaces, the metal-smelting industries consumed 66.66 per cent, the metal working and the iron and steel finishing trades 9.96 per cent, and the machine and apparatus industries 2.03 per cent. Since the Ruhr basin is the seat of the most important of these industries, the above figures show the importance of their participation in the coal production.

ORE PRODUCTION AND IMPORTATION.

The iron-ore production of the Empire is not commensurate with the coal production. However, it has developed somewhat in proportion to the development of the iron and steel industries. In 1885 the total production of iron ore was 9,158,000 tons; in 1890, 11,406,000 tons; in 1900, 18,964,000 tons; in 1907, 27,697,000 tons. The value in 1907 was $28,368,000. The insufficiency of the native supply of ore is strikingly illustrated in the figures of imports and exports. In 1907, for example, the imports of iron ore amounted to 8,476,076 tons, valued at $38,562,000, while the exports were 3,904,408 tons, valued at $4,777,000. This excess of 4,500,000 tons of imports over exports shows the true relation only when the values are given, and indicates the low-grade ores which are exported, and the high-grade ores which have to be imported for the industry. An analysis of the imports also shows a distinction in the over-seas and the Continental ores. The leading sources of foreign supply are indicated in the importations of iron ore for 1907 as follows:

Country.	Quantity.	Value.	
	Metric tons.	*Marks.*	*Dollars.* [a]
Belgium	380,152	5,512,000	1,311,856
France	791,520	11,477,000	2,731,526
Greece	183,228	3,298,000	784,924
Austria-Hungary	296,212	5,924,000	1,409,912
Russia	664,536	15,616,000	3,716,608
Sweden	3,603,505	68,476,000	16,297,288
Spain	2,149,299	44,061,000	10,486,518
Algiers	196,571	4,128,000	981,464
Newfoundland	98,571	1,725,000	410,550

[a] The mark is reduced to American currency on the basis of 23.8 cents, except for small sums, where it is taken at 24 cents.

This indicates the dependence on Swedish and Spanish ores. Importations from Spain have decreased since 1906, when they amounted to 3,631,000 tons; on the other hand, the Swedish imports have risen to the present quantity from 1,438,000 tons in 1900. Importations of three-quarters of a million tons of ore from France will be noted. Some of this is from the French territory of the Lorraine district, but increasing quantities are now coming from the Meurthe-Moselle district, which produces a much higher grade of ore, and which in the future will furnish increased quantities to the German iron and steel industries. Some ore containing less than 25 per cent of iron is mined in upper Silesia, and there are also mines in Hanover and in the Hartmund district of Westphalia. The main ore production of the Rhenish provinces is in the Siegen district, of which Bonn is the commercial center. In 1907 the quantity was 3,372,000 tons, out of a total of 5,078,000 tons for all Prussia.

PRINCIPAL SOURCE OF SUPPLY.

The principal source of supply for the German industries, is in the annexed territory of Alsace-Lorraine and the Grand Duchy of Luxemburg. Since Luxemburg is a member of the Customs Union, or Zollverein, its products are included in the statistics of the German Empire. The ore of this region is of the low grade known as "minette," which contains 30 to 32 per cent of iron. The total production of the Lorraine-Luxemburg district in 1907 was 21,601,000 tons, of which 14,108,000 tons were credited to Alsace-Lorraine and 7,493,000 tons to Luxemburg. It is this district which furnishes the bulk of the German exports of ore, since the Belgian iron and steel industries draw on it heavily.

PIG-IRON DISTRICTS.

A better measure of the advance of the German industry is afforded in the next step beyond the assembling of the raw material; that is, the production of the raw iron. In 1887 the output of all kinds of raw iron was 4,024,000 tons; in 1897, 6,881,500 tons; and in 1907, 13,045,790 tons. In twenty years, therefore, the production has increased more than threefold. Unquestionably 1907 is the high-water mark for some years to come. The total for 1908, owing to various causes, will be less than 12,000,000 tons. The different classes of raw iron also indicate the tendencies in the constantly increasing proportion of Thomas iron produced. The total in 1907 of the different classes was: Foundry iron, 2,259,416; bessemer, 471,355; Thomas, 8,491,226; steel and spiegel iron, 1,034,650; puddle iron, 786,113 tons.

The progress of this industry is shown in a different way in the totals of production and the proportion of home consumption. In 1890 the production was 213.6 pounds and the home consumption 179.7 pounds per capita. In 1907 the production was 463.2 pounds and the home consumption 323.5 pounds per capita. The increase in population of the German Empire has been one of the bases of the increased production and consumption of raw iron.

LOCATION OF PRODUCING DISTRICTS.

The pig-iron production is not only the measure of the general advance, but it also indicates the location of the producing districts and shows on what the diversification of the German iron and steel industry is based. For example, of the total production of 13,045,790 tons in 1907, Prussia is credited with 8,626,300 tons. The Prussian production itself is in the geographically sundered districts of Silesia and the Rhine. The production in Silesia was 939,627 tons. In the Bonn district it was 2,847,080 tons. This is part of the Rhenish-Westphalia output which in reality is located in the Ruhr coal basin with the Dortmund district as the center. The total production of this district in 1907 was 4,314,413 tons. Against this was the production of 3,989,922 tons in the imperial territory of Alsace-Lorraine and Luxemburg.

PERMANENT SEAT OF THE GERMAN INDUSTRY.

The comparative figures of the Dortmund-Bonn and the Lorraine-Luxemburg districts raise the question of the permanent seat of the German iron and steel industry. The sources of fuel supply are in

the Rhenish-Westphalia section, the native ore supply in the Lorraine-Luxemburg section.

When the German industry was making vigorous strides in the first period of its rapid development—that is, in the decade from 1890 to 1900—the belief was held by many experts that the tendency of the blast furnaces and steel plants to move from the coal fields to the ore beds would become so strong that ultimately the Lorraine-Luxemburg district would be the principal seat of production. For a time the movement was pronounced enough to justify this belief. Heavy investments were made in Luxemburg and Lorraine, not only by German capitalists, but by foreigners as well, a group of Belgian capitalists having expended large sums in new plants. This emphasized the fact that while Germany controlled the productive resources their commercial exploitation, and therefore to some extent the shaping of the future iron industry, was not exclusively in Germany's hands. However, while the tendency was from the coal fields to the ore beds there were counter tendencies, and the movement was not an unchecked one. Lorraine and Luxemburg could make pig iron at from $2 to $2.25 per ton lower than the Ruhr basin. But the latter could import Swedish and Spanish ores and had advantages in the way of transportation for the finished product which exceeded the facilities afforded Lorraine and Luxemburg by the junction of the Moselle River with the upper Rhine. Some of the Continental territory naturally fell to the Lorraine-Luxemburg works, and they could even reach northern Germany on a competitive but not an advantageous basis.

THE RUHR BASIN PLANTS.

So much fresh capital invested in new plants at first also gave them cheaper means of production than the older establishments of the Ruhr Basin, where the entire rehabilitation of old plants and the installation of the newest labor-saving equipment was not immediately practicable. This condition, however, gradually changed until the Ruhr Basin plants were fairly well supplied with modern equipment. The movement has now come to an end through natural causes. To protect themselves the Ruhr industries bought ore beds in Lorraine and Luxemburg, and the plants established there extended their holdings. The result is that all the ore beds are now taken, and while there is a large reserve of good ore, as "minette" ore goes, none of it is available for new establishments, while the quality of "minette" mined also shows deterioration.

THE MEURTHE-MOSELLE DISTRICT.

More importance attaches to the discoveries of the last ten years in French territory, in what is known as the "Meurthe-Moselle district." This is part of the Lorraine-Luxemburg iron area whose fringe ex-

tends into Belgium as well, but the significance of the new exploitations in the French section is that the quality of the ore obtained is much superior to the "minette" ore, and is of special utility in the making of Thomas pig iron. It runs from 37 to 38 per cent of iron, as against 30 to 32 per cent in the Lorraine-Luxemburg Basin. The qualities which render it especially valuable are the compactness of the mineral and the constant yield in phosphorus. The Meurthe-Moselle territory is comprised in three districts, known as the "Longwy," the "Nancy," and the "Briey" basins. Briey is the chief producer, its output about equaling that of the other two districts. The quantity extracted in 1907 was 8,739,000 tons, or 83 per cent of the total tonnage of all France. In 1897 the production of this district was 3,804,000 tons, so that in ten years the production more than doubled.

The effect of the Meurthe-Moselle discoveries was felt both in Belgium and in the rival districts of Germany. Belgium, which is the competitor of the German iron and steel works, is drawing more than 1,000,000 tons of ore annually from this district. The imports into Lorraine and Luxemburg and into Westphalia are now about 400,000 tons, but a large increase is looked for in the future. Both the Luxemburg and the Westphalia companies acquired interests in the French deposits. Some of the Westphalia companies bought their interests outright, while others effected an exchange of stock and a working arrangement with the French companies.

DOMINANCE OF THE RUHR DISTRICT.

The Ruhr Basin industries, with their fuel supply at the doors of the blast furnaces, and with the assurance of future ore supplies from the French territory, whose superiority over the "minette" ores more than balances the freight charge for the longer haul, and with constantly improving facilities for obtaining the Spanish and Swedish ores, now feel secure of the future. Without impairing the importance of the Lorraine-Luxemburg industries, it nevertheless may be said that the dominance of the Ruhr Basin in iron and steel production is not overthrown, and while not supreme it yet has a marked influence on the home trade and the foreign market. On account of the prominent position of the Ruhr industry, I have therefore taken it to a larger extent than the other sections for illustrating the underlying conditions of the German iron and steel trade.

The Ruhr Basin, industrially, may be said to be comprised within what is known as the "Dortmund district," of which the city of Dortmund is the heart. The Dortmund district includes every form of iron and steel production, from the mining of the coal deposits to the placing of highly finished products on the market. It blazes with blast furnaces, foundries, rolling mills, and factories for the

finished products. Besides the city of Dortmund, it includes the great coal-mining field of Bochum; Essen, with its coal mines and gun factories; Mulheim on the Ruhr, with rolling mills; and other centers of the blast furnaces and foundries. It also includes Dusseldorf, which, besides being the seat of the metal-working trades, is the executive headquarters of the iron and steel industries generally. Close to Dusseldorf are Remscheld, the principal seat of the manufacture of hand tools, and Solingen, the seat of the hardware and cutlery industry. Taking the district as a whole, the manufactures include rails and railway ties, railway superstructures, beams and girders, pipes and tubes, plates and rivets, bridges, locomotives, machines, heavy ordnance, and the various forms of the highly finished products.

The iron ore which is obtained in the Dortmund district is negligible, not amounting to 500,000 tons annually, but the coal production now exceeds 80,000,000 tons annually, and employs nearly 300,000 workmen. The pig iron product in 1907 was 4,314,412 tons, valued at 296,305,100 marks, or $70,520,613.

PRICE MOVEMENTS.

In the period since 1897 price movements of fuel, ores, and raw iron have shown wide fluctuation. They are summarized from year to year by the Dusseldorf trade journal, Stahl and Eissen (Steel and Iron), which is the recognized authority. Figures taken from this source show that the inland trade prices were in January, 1897: Coke coals, 8.25 marks ($1.98) per ton; furnace coke, 13 marks ($3.12); foundry, 16 marks ($3.84). In January, 1908, the quotations were: Coke coals, 12.50 marks ($3); furnace, 18.25 marks ($4.28); foundry, 19.60 marks ($4.70). There was no increase in coke coals from 1897 to 1900, although coke had advanced 1.50 marks (36 cents), and foundry had gradually gone up to 20 marks ($4.80) per ton. In the spring of 1900, however, coking coal prices were advanced to 10.75 marks ($2.58), and continued at that figure until April, 1902, when they were reduced to 9.75 marks ($2.34), at which quotation they remained until April, 1906, when there was an advance of 1 mark (24 cents). This held for a year, when a further advance was made to 12.50 marks ($3). This was the rate in January, 1908, and was the price fixed by the coal syndicate for the year.

FURNACE AND FOUNDRY COKE.

In the period from 1897 to 1907 inclusive, the highest price reached for furnace coke was 22 marks ($5.28) per ton, in the latter part of 1900, and throughout 1901. It then dropped to 15 marks ($3.60), at which figure it remained until April, 1906, when an advance to 15.50 marks ($3.72) was made. In April, 1907, a further advance to 18.25 marks ($4.38) was made. In October, 1908, the quotations for furnace coke ranged from 16.50 to 18.50 marks ($3.96 to $4.44.)

Foundry coke reached the highest quotation in April, 1900, when the price was 20.40 marks ($4.89). It remained at these figures for a year and then dropped to 16 marks ($3.84), from which there was a gradual decrease to 13.50 marks ($3.24) in the last quarter of 1904. For October, 1908, the quotations were 15.50 marks ($3.72). The reduction of 2 marks (48 cents) per ton on furnace and foundry coke does not become effective until January, 1909.

QUOTATIONS FOR THE SEVERAL GRADES.

On the technical side of the subject the quotations of the different grades of coal, coke, and briquets are of interest. These are sum-

marized from the quotations of the Essen Bourse for several years in terms of marks (24 cents), as follows:

Year.	Coal.				Coke.		Briquets.
	Gas.	Flame.	Fat.	Lean.	Foundry.	Furnace.	
	Marks.	*Marks.*	*Marks.*	*Marks.*	*Marks.*	*Marks.*	*Marks.*
1885	7.33	5.89	5.63	4.70	.....	.....	.....
1890	14.58	12.36	10.72	11.00	22.00	19.78	14.64
1900	12.75	10.00	10.25	9.50	23.33	21.29	13.50
1904	11.75	9.38	9.38	8.25	16.50	15.00	12.00
1907	13.44	11.12	11.12	10.38	19.63	17.25	12.72

For stone coal Dortmund may be taken as the representative district. Prices for the two grades, at the works, had the following grades:

Year.	Broken.	Puddle.	Year.	Broken.	Puddle.
	Marks.	*Marks.*		*Marks.*	*Marks.*
1885	7.2	5.1	1904	11.8	9.0
1890	12.9	9.9	1907	12.5	10.8
1900	13.6	9.9			

Prices of two leading grades of English coal at Hamburg during the same period has been as given below:

Year.	West Hartley steam.	Sunderland.	Year.	West Hartley steam.	Sunderland.
	Marks.	*Marks.*		*Marks.*	*Marks.*
1885	13.3	12.5	1904	15.2	16.6
1890	18.3	18.6	1907	18.2	20.5
1900	22.4	27.7			

PRICES OF FOREIGN ORE.

During the period from 1897 to 1907, inclusive, foreign ore prices followed the international fluctuations, and native ores showed similar changes. At the beginning of 1897 brown "minette" was quoted at 3.40 marks (82 cents), and the advance was gradual until the top notch of 4.40 marks ($1.05) was reached in 1901. In the subsequent year there was a drop of 2.85 marks, which continued throughout the early part of 1904, when a gradual advance to 3 marks was made. By the beginning of 1907 it had reached 4.10 marks. It then dropped to 3 marks for the last quarter of the year. Rubio, which started at 7.50 ($1.80) in 1897, advanced to 8.40 marks in April, and continued until it reached 11.10 marks at the beginning of 1900. In April it dropped to 10 marks, and continued around these figures until the beginning of 1902, when it advanced to 10.90 marks, then gradually rose to 11.20, with occasional drops of one-half to three-fourths. In 1906 it advanced to 14 marks, and rose to 15 marks ($3.60) throughout 1907.

Raw iron prices have shown fluctuations not always in exact relation to coal and ore prices. Thomas pig iron in January, 1897, was quoted at 58 marks ($13.92), and in April advanced to 60.50 marks ($14.52). This price was maintained with little variation until January, 1899, when the figures were 61 marks. Then came an advance to 72 marks in April and to 86 marks in October, with a further advance to 90 marks in 1900. In 1902 the quotation had dropped back to 57.50 marks, and remained at this figure until October, 1905, when it advanced to 60.15 marks, steadily rising, until in July, 1906, it was at 72.75 marks, and in July, 1907, 76 marks. The falling prices, which became apparent in the beginning of 1908, have continued throughout the year. In October, 1908, Thomas raw iron was quoted at 64.80 marks ($5.55) as against 76 marks the previous year, and other classes had dropped proportionately.

RANGE OF PRICES FOR RAW IRON.

The price range of the different classes of raw iron for a series of years can be shown in a comparative statement, taking Hartmund and Dusseldorf as the points for the German products and Hamburg for the English raw iron, and following the trade designations. This comparison gives the following average of yearly prices:

Year.	Dortmund.			Dusseldorf.			British raw iron at Hamburg.	
	Bessemer raw.	Westphalia puddle.	Thomas raw.	Best German puddle, raw.	Best German pig.	Luxemburg pig.	Scotch.	Middlesborough.
	Marks.	*Marks.*	*Marks.*	*Marks.*	*Marks.*	*Marks.*	*Marks.*	*Marks.*
1885	45.8	44.2	41.3	44.5	58.4	.....	61.5	48.9
1890	79.8	70.0	61.0	77.5	83.6	.....	89.1	70.8
1900	86.7	74.3	78.0	88.8	101.4	85.8	105.1	90.8
1902	74.0	59.3	57.0	59.4	65.2	48.7	85.7	69.6
1905	62.0	57.0	56.0	56.8	68.3	52.0	78.4	67.5
1907	88.0	78.0	67.7	78.0	84.3	71.2	92.8	76.0

COST OF PRODUCTION.

So many factors enter into the cost of production that no absolute standard can be taken. Blast furnaces and rolling mills located in different sections naturally have variations in the cost of their fuel and ore, and these disadvantages are sometimes equalized by advantages in the freight rates and the nearness of the markets for the half-finished products. However, the marketing of the product is not here considered in connection with the cost of production. Information obtained from those identified with the industry and confirmed by disinterested trade authorities gives the following results, which may be taken as the average obtaining in the localities named in 1908:

	Marks.		
Dortmund district and city:			
Cost of 1 ton basic raw iron	57.00–60.00=	$13.57–	$14.28
Conversion 1 ton raw iron to steel	14.00–16.00=	3.33–	3.81
Labor cost 1 ton basic raw iron	3.50– 4.00=	.84–	.96
Luxemburg:			
One ton basic pig iron with 1½ per cent of manganese	52.00–53.00=	12.38–	12.61
Conversion 1 ton pig iron into steel billets	24.00–25.00=	5.71–	5.95
Labor cost 1 ton pig iron	2.50– 3.00=	.60–	.72

ANALYSES OF FIGURES.

The figures for Dortmund may be taken as absolute. Those for Luxemburg are high, it being understood that with the prices prevailing in the fall and early winter of 1908 pig iron could be produced at the works at 48 marks ($11.42) per ton. The Lorraine works, however, approach the figures given. At Aix-la-Chapelle, which is not a large producer of pig iron, the cost is $12.60 to $13.10 per ton. The works there buy in considerable quantities from the blast furnaces of the other sections.

The difference in the cost of converting the raw iron into steel at Dortmund and at Luxemburg will be noticed. It reflects the advantage which the Lorraine-Luxemburg works have in the matter of ore at the works.

At Dortmund in 1908 the minimum cost of producing 1 ton of raw iron was $13.57 and 1 ton of steel $16.90. Assuming that all conditions for the cheapest production coincided at Luxemburg, the bottom figure, lower than the average estimate, was $11.42 for pig iron and $17.13 for steel. Apparently in no case does the labor cost of 1 ton of pig iron amount to $1.

It is not practicable to follow the cost of productions beyond the raw iron and steel, but a basis exists for determining the proportions of raw steel which enter into the production of half-finished products.

RESULTS IN GROUPS.

This exists in the tables of the companies which compose the steel syndicate and which in their operations among themselves have a fixed standard for estimating the material to be realized. This technical standard gives the following results in some of the groups; 1,000 tons of raw ingots give a net weight of—

	Tons.
Half stuff:	
Blooms and slabs	910
Square billets	885
Flat billets	875
Plates	875
Railway material:	
Rails weighing 15 kilos and more per yard	840
Cross rails weighing 15 kilos and more per meter	835
Rails weighing less than 15 kilos	830
Cross rails weighing less than 15 kilos	800
Form iron:	
Weighing less than 20 kilos per meter	805
Weighing from 20 to 100 kilos	865
Weighing more than 100 kilos	795
Merchant bar iron products: Merchant products of all dimensions and drawn wires	860
Machine group	870
Wrought iron:	
Thick black	760
Thin wrought	700
Tubes:	
Welded	800
Unwelded	865
Cast-iron forgings:	
All kinds of screws for railways	810
Wheel axles for railway cars	650
Crank axles	750
Wheel coverings, rough casting	930
Steel moldings, including wheel covering for engines	750
Rough forgings of all kinds	800
Steel cylinders and moldings	800

Some exceptions are made in the quantities for different works, but the average holds good.

WAGES AND WORKMEN.

The wages element in the cost of iron and steel production begins at the coal mine. Approximately 500,000 persons are employed in coal mining in the German Empire. Owing to the government regulations statistics of wages in coal mining are more complete and trustworthy than in the related industries and the data is more fully classified. In the German mining industry the practice is to divide the operatives into groups or classes—the underground workers, or miners proper, the miscellaneous underground workers, and the overhead men. To obtain a general idea of the industrv however, it is not necessary to follow these subdivisions.

COAL MINING WAGES.

The movement of coal mining wages for a series of years is best exhibited in tabular form, the Dortmund district being taken as the basis for comparison. The full statistics of this district for a series of years and of other districts for a single year are as follows:

Year.	Number of miners.	Total wages.	Annual wage per head.	Wage per shift.	
				Marks.	
Dortmund district:					
1886	99,952	$18,370,852	$183.74	2.58	$0.615
1890	123,984	31,496,743	253.95	3.49	.831
1895	150,212	34,618,610	230.38	3.18	.757
1900	220,031	69,736,566	317.02	4.18	.995
1902	236,543	63,692,048	269.18	3.82	.909
1903	248,120	71,160,387	286.79	3.88	.923
1904	262,037	75,357,087	287.50	3.98	.926
1905	259,608	73,257,334	272.27	4.03	.957
1906	270,288	90,166,666	336.68	4.37	1.04
1907	294,101	109,344,553	371.76	4.87	1.16
Upper Silesia:					
1907	94,367	22,523,452	238.71	3.48	.83
Lower Silesia:					
1907	25,792	6,076,878	235.62	3.27	.778
Saar district:					
1907	48,895	13,793,200	272.03	4.02	.95
Aix-la-Chapelle district:					
1907	18,921	6,532,275	346.27	4.64	1.10

Complete statistics for 1901 are not available. In 1905 the protracted strike of the miners was the cause of the reduction in the aggregate earnings.

From these figures it appears that the wages are highest in the Dortmund district, where a majority of the miners are employed. Here the aggregate annual earnings in 1890 were 1,067 marks ($371.76), and 4.87 marks ($1.16) per shift in 1907. One company gives the wages prevailing in its coal mines in 1908 as follows, per shift: Miners, 5.98 marks ($1.43); other underground workers, 4.04 marks (97 cents); overhead labor, 3.88 marks (93 cents).

RELATIVE RATES OF MILL WAGES.

Wages in the iron and steel industries and in the allied manufacturing trades can not be given with the same completeness as coal miners' wages. There are variations due to local circumstances, and the labor cost in different districts, and even in different sections of the same district, is not always uniform. Some leading sections in which the industries were made the subject of inquiries in 1905 have been taken. The general statement is made by the employers that in these industries the increase of wages from 1905 to 1908 reached 12 per cent.

In the blast furnaces, rolling mills, and foundries ten hours daily or sixty hours weekly are taken as the average of actual labor, though in some cases it is necessary to allow for twelve hours per day of seventy-two hours per week as the time required for the workmen to be on call.

DAILY WAGES AT DORTMUND.

The following is given as the daily wage rate for 1908 in one of the largest plants in the Dortmund district:

	Marks.		Marks.
First roller	12.70=$3.05	First smelter	8.00=$1.92
First welder	10.40= 2.50	Ore loaders	5.35= 1.28
Converter man	8.82= 2.22	Unloaders	4.50= 1.08
First hammerman	8.40= 2.02		

WEEKLY WAGES AT DÜSSELDORF.

For Düsseldorf the following figures of the weekly wage rates were furnished:

	Marks.	
Puddlers	56.00–67.00=	$13.44–$13.68
Rollers	40.00–56.00=	9.60– 13.44
Core makers	35.00=	8.40
Shearing men	28.00=	6.72
Smelters	41.00=	9.84
Pipe welders	56.00–78.00=	13.44– 18.72
Steel furnace men and founders	34.00–35.00=	8.16– 8.40
Laborers	22.00–28.50=	5.28– 5.84

WEEKLY WAGES AT AIX LA CHAPELLE.

Another grouping is made at Aix la Chapelle, whose industries are on a different basis than those of the Dortmund district. The table that follows gives the weekly wages:

	Marks.	
Steel rollers	49–52=	$11.76–$12.48
Second men	36–42=	8.64– 10.08
Third men	32–35=	7.68– 8.40
Welders	40–46=	9.60– 11.04
Charge men	25–28=	6.00– 6.72
Wire rollers	20–32=	4.80– 7.68
Core makers	30–38=	7.20– 9.02
Smelters	20–30=	4.80– 7.20
Laborers	12–30=	2.88– 7.20

In the Aix-La-Chapelle mills foremen receive 55 to 60 marks ($13.20 to $14.40) and upward per week. In the finishing industries statistics published show that workers in the machine and small iron and steel industries in the Dusseldorf district in 1907 numbered 227,091 persons, whose average wages were 1,448 marks ($344.62) per year.

RELATION OF WAGES TO PRODUCTION.

A fuller understanding of the wages and other elements that enter into the cost of production is obtained from the reports of the various companies. These are usually quite complete, especially as to wages and the various pension and insurance funds. The reports also give the degree to which taxes enter into the cost of production. For purposes of illustration three leading companies of the Rhenish-Westphalia provinces are taken, though the number might be multiplied indefinitely. The companies are the Harpener, the Phoenix, and the Hoesch. The fiscal year is from July to July, and the reports are made public in October, so that those cited are for the fiscal year 1907–8.

The Harpener, of Dortmund, is a coal company controlling important groups of mines. In 1908 it employed 28,542 workingmen, to whom it paid 50,691,943 marks ($12,064,782) in wages. Its total coal production was 7,405,532 tons. The average was 5.14 marks ($1.23) per man and shift, the mining cost per ton on the net production 8.63 marks, to which was added 72 pfennig for general cost, bringing the total up to 9.35 marks ($2.24), as against 8.64 marks ($2.07) in 1907. The average wages were 4.68 per cent higher than the previous year. The average receipts for coal was 11.3 marks ($2.71) per ton, as against 10.5 marks ($2.52) the previous year.

The taxes were as follows: State, 189,560 marks ($45,115); local, 1,251,478 marks ($297,852); total, $314,967.

The contributions to the various pension and insurance funds are grouped below, the first column indicating the company's proportion, which, whether taken as in direct wages or as part of the working expenses, is an element of cost, and the second the amounts which were charged to the workmen's wages.

Fund.	Company.	Workmen.
Pensions and support	$248,515	$271,392
Sickness	177,190	203,122
Invalid and old age	65,430	65,422

In addition to the above funds were the officers' pension and the life and accident association contributions, but the latter would hardly be classed under cost of production.

EMPLOYEES, WAGES, AND PRODUCTION.

The capital stock of the Harpener Company is 72,200,000 marks ($17,183,600). On this it paid the regular dividend of 4 per cent, with an extra dividend of 7 per cent, or 11 per cent in all, the total dividend payment amounting to 7,942,000 marks ($1,890,196).

The Phoenix Company, which is located at Laar, near the junction of the Rhine and Ruhr rivers, is engaged in coal mining and the various branches of the iron industry. It has extensive blast furnaces, foundries, and rolling mills. It employs 34,475 workmen, to whom the total wages paid amounted to 51,227,153 marks ($12,192,062). The amount of wages per capita for all workmen was 1,577 marks ($375.32) as against 1,523 marks ($362.47) the previous year. The company's coal production for the year was 4,177,450 tons, of which 2,212,330 tons were sold and the balance used by the works. The miners employed numbered 13,863.

In the rolling mills, etc., the workmen number 13,816 and the total sum paid them for wages was 20,266,497 marks ($4,832,426). In the previous year there were 13,952 workmen and the total wage payment was 20,241,713 marks. This company does not give in detail the different proportions of the amounts credited to the insurance, accident, and other funds, but the total is placed at 2,848,937 marks. The company paid a dividend of 11 per cent os 11,000,000 marks ($2,618,000).

The Hoesch Iron and Steel Works of Dortmund employ about 9,000 men in the collieries and the industrial branches. This company has a capital stock of 16,800,000 marks on which it paid a dividend of 14 per cent, 2,352,000 marks, for the year 1907–8.

Among the contributions to various funds entering into working expenses or indirect wages were as follows:

State taxes	$22,273	Invalidity	$19,718
Local taxes	97,417	Officers' pensions	9,100
Sickness	21,451		

STRENGTH OF TRADE UNIONS.

Trade unions are much stronger in the coal mining than in the iron industries, the aggregate number of members in the miners' unions far exceeding those of the iron and steel unions, where the latter exist at all. Both the coal miners and the iron and steel workers, however, exercise a definite though somewhat subtle influence on the wage rate through the political organization of the Social Democratic party, and also indirectly and in a lesser degree through the organization of the Christian or Roman Catholic Church Union, which undertakes to combat socialism. The coal miners after the strike of 1905 secured stringent state legislation which, while it had no direct influence on the wage rate, according to the employers, raised the price of production through the increased expense necessary to conform to

its requirements. Public sentiment, however, supports these stringent regulations, and at times it is quickened into possibly unreasonable demands by disasters such as the explosion at the Radbod mine in November last, when 360 miners lost their lives.

EMPLOYERS' CONTRIBUTIONS A FACTOR.

Exact calculation can not be made of the addition to the wage rate which comes from the employers' contributions to the sick, invalid, accident, old age, and pension funds, but the aggregate is considerable, and whether reckoned as a part of the wage rate or as subtracted from the remuneration of capital, it is a factor in the cost of production. Many of the companies also supplement these compulsory contributions by contributing to the mutual benefit societies and by pensions and other funds for officers and employees who are not included under the grade of workmen. Contributions of this kind, as well as the bonus which is paid to the officers in addition to their salaries according to profits earned for a given period, usually are credited to working expenses.

A general review of the workings of these different insurance funds would require too much space and only a few points are given. It is to be observed that in the coal mining regions the accident insurance is a most important factor.

THE INSURANCE FUNDS.

The "Allgemeiner Knaapsches-Verein" of Bochum, for 1907, reported 309,311 members, an increase of nearly 8 per cent over the previous year. The total receipts for the year were 42,804,000 marks ($10,187,352), and the total outlay 34,613,000 marks ($8,237,894). The workings of the society are shown in the following summaries:

Fund.	Receipts.	Expenditures.	Fund.	Receipts.	Expenditures.
Sickness	$4,165,000	$3,333,190	Invalidity	$1,488,690	$1,101,226
Pension	4,531,282	3,803,478			
			Total	10,187,352	8,237,894

For a sickness-fund member the average yearly payment was: Contributions of members, $7.46; contributions of owners, $5.60; total, $13.07. The number of cases of illness in connection with incapability of earning the living in the year 1907 amounted to 199,581.

A member paying contributions to the pension and the relief fund fared as follows: Of the total receipts, $19.18; of the total expenses, $16.09; of the clear profits, $3.08.

For the annuitants the following average was paid: Invalidity (annuitants included), $46.76; life annuitants, $46.11; total average, $46.43.

The resources of the society amounted to: Sickness and pension fund, $14,903,622; invalidity and life annuity fund, $10,091,710.

CONDITIONS OF WORKING CLASSES.

The conditions of living of the German working classes, the retail prices of food, clothing, fuel, and rents, have been the subject of recent investigations, and I do not consider it necessary to cover this ground. A few general observations may be made. In the active period after the depression of 1901 and 1902 the coal miners and the workmen in the iron industry shared very generally in the period of prosperity. Wages were raised and employment was universal. This increase in the wage rate, together with the high cost of raw material, was one of the reasons given by the manufacturers for their disappointingly small profits in the face of the active demand. How far the increase in wages was balanced by the increased cost of living can only be determined by minute comparison of tables of retail prices.

Regarding housing conditions, in most of the industrial centers the workmen appear to be fairly well provided for. The development of many of these industrial centers has been so rapid that whole new cities of wage-workers have grown up for whom entirely new tenements had to be built. In only a few of the active industrial centers are large proportions of the workmen crowded in the unsanitary and contracted quarters which mark the old German cities. In the mining regions throughout the Ruhr basin many of the companies have made provision for their miners by erecting special dwellings, cottages, etc. Although some of these tenements appear to be crowded, this is said to be due to the desire of the occupants to reduce their own rent by taking in lodgers. The state and municipal regulations are generally sufficient to guard against unsanitary results from this system. In the Dortmund and other districts some of the iron and steel mills seek to provide dwellings not only for their superintendents and similar employees, but also for a part of their ordinary workmen.

WAGES AND COST OF LIVING.

Relating to wages and the cost of living, the depression which has existed during the year 1908 and the certainty that it is not fairly ended raise some new questions. Some of these can only be matters of opinion. It seems, however, to be agreed that while the present figures may be lowered, the wage rate has been advanced permanently. During the period of depression there have been few actual reductions of wages, the loss being shown in short-time work and in the large increase of unemployment. There has been no general decrease in the wage rate for coal mining, though employers insist that a new period of general activity and prosperity can not be assured without

some reduction in labor, the forerunner of which already appears in the reduction of prices of ore and pig iron. The coal syndicate held off reducing the price of coal, for one reason, on the ostensible ground that this reduction would mean reduced wages with labor troubles, and it was desirable in the interest of the public that the conditions which marked the long strike of 1905 should not be repeated. However, since the announcement has been made of lower prices for 1909, the attempt may be made to secure lower wages. Yet this is less likely to be successful in the case of the coal mines than of other industries.

No general reduction in the wage rate has been made by the industries of the Rhenish Westphalia district since the depression set in, but the number of employees has been sensibly diminished and short time for those employed has been the rule. In Luxemburg a reduction ranging from 4 to 10 per cent on all workmen receiving more than 90 cents per day was announced in November.

COMPULSORY INSURANCE AGAINST SICKNESS.

The effect of the German state system of compulsory insurance against sickness, accident, old age, etc., has been put to a partial test during the existing depression. In the highly paternalistic scheme of compulsory insurance which has been worked out by the State the point has not yet been reached where insurance is provided against unemployment. Nevertheless, the existing arrangement of provision against sickness and of old-age pensions has decreased the burden of the active workers during the period of unemployment, and is therefore to be given some credit for mitigating a bad industrial situation. Some of the workingmen's groups, in addition to the state insurance to which they are forced to contribute, also have mutual benefit societies of their own, and these likewise have been able to be of assistance in the crisis. In this way it has resulted that the distress which accompanies a prolonged industrial depresssion has been less keen though not entirely avoided. Nevertheless, many employers, and inferentially some of the workingmen's organizations, still question the system. On the employers' part there is a practically universal complaint that with the certainty of the provision for his relief in sickness and old age the workman is losing all independence and is becoming less and less efficient. On the part of the workmen the objection is heard that wages are kept below what might be obtained if it were not for these enforced contributions and, moreover, that their own liberty of action is restricted. It is fairly clear that at the present scale of wages the margin between the cost of living and the total pay is so small as to afford practically no chance for saving by individuals beyond their contributions to the obligatory and the voluntary funds.

TRUSTS AND SYNDICATES.

The influence of the combinations, which are variously described as trusts, syndicates, or kartells, is exhibited very clearly in the different branches of the iron and steel trade. From the first stage, which is the coal in the ground, to the last stage, which is the making of the most highly finished articles, between 75 and 80 syndicates are concerned in the manufacture and sale of iron and steel products. This industry therefore furnishes an excellent means of judging how the principle of combination is worked out in the industrial and commercial system of Germany. It is not yet universally accepted as an established case of evolution, for doubts are entertained by some economists whether the system has not been carried to the point where a retrogression in the interest of free competition is desirable. But the existing syndicates or kartells, in their purposes and their methods and their relation to production and distribution as well as to prices, may be examined critically and impartially.

OPERATIONS OF THE SYNDICATE SYSTEM.

All the syndicates are governed by statutes of their own making, which, if they have not the force of statute law, at least have the same effect on the organizations for which they are devised. The details of these regulations are rarely made public, but their general nature becomes known through their operation. A common model apparently has served for the majority of them, the adaptation being made to the special circumstances of the particular industries which may be formed into a syndicate.

The A B C of the syndicate system as applied to the iron and steel industry is concentrated in the following group: The coal syndicate, the coke syndicate, by-product syndicates, raw iron syndicates, and steel works syndicate.

Coal, which is as much raw material to the iron and steel industry as is the iron ore, is effectually controlled by the Westphalian Coal Syndicate. The coal industry enjoys no protective tariff duties, as do most of the finishing industries. There is, moreover, the competitive supply of the coal fields of the United Kingdom, with easy water transportation to the German ports, and to many of the inland points through the river and canal systems. Nevertheless, the Westphalian Coal Syndicate enjoys a substantial monopoly of supplying coal to the iron trade.

ORIGIN OF THE SYSTEM.

The germ of this syndicate was disclosed in 1878, when a number of the leading mines formed a combination to raise prices to a remunerative level by preventing overproduction. This agreement related to the prices of gas coal, and it was supplemented three years later by one for the control of open-burning coal. For several years thereafter various combinations were made for restricting the output, but they were usually local in their sphere and their efforts to regulate the selling prices were not wholly successful. A stronger organization was the Mine Owners' Syndicate, which was formed in 1891. This, however, went to pieces in the following year during a period of severe industrial depression. It was succeeded by the Coal Group, which had been established as far back as 1880. Out of the two organizations grew the Rhenish-Westphalian Syndicate, which was formed in 1893 and renewed at various periods, the last one being December 31, 1905, when an agreement was reached for ten years, or until January 1, 1916.

WORKING MACHINERY AND METHODS.

The working machinery of the syndicate is through a stock company with a small capital, whose shares belong to the owners of the coal mines in the combination. Shares can not be transferred except by the consent of the association. The stated objects are the purchase and sale of coal, coke, and briquettes. Constituent mines bind themselves to sell all their output to the syndicate except that which is needed for their own purposes and for local consumption. This has become a very important reservation since the purchase of collieries by the blast furnaces and rolling mills. The syndicate has the right to sell the product of other mines than those whose coal has been sold through the syndicate, in accordance with an elaborate system which governs their participation and their allotments. The internal managements regulates the relation of the mines to the central organization and various penalties are provided for infringing the regulations. The chief interest is not, however, in the regulation of the members among themselves, but in the relation of the syndicate to the consumers—that is, to the general public. The market is divided into groups and there are several divisions for the different classes of coal. Selling bureaus are established at various centers where coal is delivered to dealers who control the retail trade. The minimum sale to any customer is 6,000 tons.

RELATION TO CONSUMERS.

In its original relation to consumers no fundamental right of free purchase in open competitive markets was recognized. The conditions under which the syndicate supplied customers was much criticised, especially one requirement known as the "exclusive selling

clause," which compelled consumers who did not buy exclusively of the syndicate to pay a fine of 50 pfennigs (12 cents) per ton in the form of increased prices on all coal which they did obtain from it. This clause was modified in 1907 on account of the inability of the syndicate mines to meet the demands and customers were free to buy where they could. However, no guarantee exists that it will not be restored, since the modification in the selling clause merely provided that the fine should not be levied in cases in which coal was purchased elsewhere for the reason that the syndicate was incapable of complying with its running contracts or was unable to supply increased demands.

SALES ABROAD AT LOWER RATES.

The syndicate has come in for the greatest criticism because of the policy of selling coal abroad cheaper that at home. In some instances exceptional reasons have been given for this course, but generally it is defended on the ground that it assures a permanent foreign market in periods of depression at home when the product of the native mines can not be entirely absorbed. In this view it is to be taken with the export policy of the German Government and of private industries which adhere to the system. The instances of sales abroad at lower prices than in the domestic market are numerous and flagrant. It is difficult to form a conclusive opinion on the general effect of the syndicate's policy on coal prices in Germany, but at times the discrepancy between home and foreign prices is a heavy burden to the domestic consumer. The fine formerly levied on customers who bought coal outside of the syndicate naturally deterred them from enjoying the benefits of the English competition. Against the general export policy it is urged that in view of the needs of the German industries fuel should not be considered on the same basis as manufactured and semimanufactured products in the need of maintaining a foreign market. In other words, that the domestic industries should have the full benefit of the native production and foreign competition to secure fuel at the lowest obtainable prices. In the industrially active year 1907 Germany produced 143,223,000 tons of mineral coal and exported 20,018,000 tons, which was an excess of 6,288,000 over the imports. However, this can not be considered purely in the economic sense, since the geographical extent of the Empire makes it profitable to export to neighboring countries when there can be no profit in transporting the coal to distant parts of the Empire itself.

SYNDICATE CONSTITUENT COLLIERIES.

As concerns the constituent collieries the syndicate's operations are usually defended on the ground that they keep in operation the smaller and less favorably situated mines which under ordinary cir-

cumstances would be obliged to close down entirely. There is some approach to unanimity in the opinion that the syndicate in periods of great demand has kept prices at a lower level than would be possible under free competition, and in periods of rapid decline has moderated the fall. This is the familiar argument of other syndicates also.

The position of the coal syndicate in 1908 appears from the report of the operations for fiscal year ending in April, which was made public in October last. In this report it is stated that under the policy of allowing the collieries to augment their participation in accordance with increased demand, the increases were 1,448,000 tons of coal, 204,804 tons of coke, and 156,900 tons of briquets. It is declared that in spite of the very active demand in 1907, and the extraordinary efforts which were made to meet it, the collieries as a whole only succeeded in increasing the output over the preceding year by 4.60 per cent. The Ruhr coal mines augmented their product by 5.09 per cent, but in the Saar district there was a decrease. In the Silesian districts the increase was 8 per cent. In the entire German Empire, including the nonsyndicate mines, the total increase was 4.94 per cent, while in the home consumption it was 8.37 per cent. This disparity between production and consumption is inferentially urged as an answer to the complaints that the syndicate was responsible for high prices. The collieries which were themselves members of the syndicate consumed much larger quantities for their own purposes than in any previous year, and consequently the quantity of coal remaining at the disposal of the syndicate for free sale only rose from 44,504,678 tons in 1906 to 45,055,451 tons in 1907, an increase of 530,773. The claim is made that the syndicate in order to meet the home demand reduced the foreign sales, and also whereever possible filled contracts by supplying foreign coal.

METHOD OF FIXING PRICES.

The method of fixing prices by the coal syndicate has come in for criticism. The fiscal year is from April to April, and the prices usually are fixed some months in advance for the whole year. This lack of flexibility it is declared was a drawback to many industries in the summer and autumn of 1908 when, though iron ores had fallen materially, no concession could be secured on coal because the contracts made ran to April, 1909. On behalf of the consumers it was urged that even if contracts had been made for the full fiscal year they should have the benefit of lower prices. These demands were incessant and were not fruitless. The most significant act of the coal syndicate since its formation, in the view of many, was taken late in November, and unquestionably was a concession to public sentiment. This was the definite abandonment of the hard and fast

policy of fixing prices in April for the full year. The urgent representation of consumers that in view of the bad condition of the trade, and moreover the falling of price of pig iron, made it nesessary for them to have a commensurate reduction in fuel was partially successful. The syndicate announced a reduction in price of blast furnace coke of 2 marks (48 cents) per ton; ordinary coal, 1¼ marks (30 cents), and from 25 pfennig (6 cents) to 1 mark for other kinds of coke as well as for briquets and industrial coal, the price of lump coal remaining unchanged.

PRESENT AND FUTURE PRICES.

More important still was the announcement that the reduction on coke for the blast furnaces would go into effect January 1, 1909, and would continue to September 30; the other prices it was declared would continue till April, 1910, or for the full syndicate year, and it was further intimated that in fixing the price of blast furnace coke until September only the right was reserved to raise it then if the market justified. The public view as voiced through the newspapers was that if the price of coke could be raised in September, 1909, it also might be lowered, and moreover the other kinds of coal and coke might also have the prices reduced, inasmuch as such action had been taken with reference to coke during the year for which its price was suposed to be fixed unalterably. The amount of the reduction on coke and industrial coal was declared to be too small, and the agitation for lower prices was not ended by the partial concessions secured.

CONTROL BY THE COAL SYNDICATE.

The mastery of the industrial situation, however, in all circumstances, seems to rest with the coal syndicate, since its control of the total production of the German Empire ranges from 55 to 60 per cent. Of more importance is the fact that the percentage is much higher in the districts requiring coal and coke for the iron and steel industries. In 1907 the production of the nonsyndicated mines in the great Ruhr coal basin, which is the seat of the Rhenish-Westphalian iron industry, was only 1,620,000 tons, or about 2 per cent of the total. Consequently there is no competition to speak of with the syndicate in this district.

The State, as represented by the Kingdom of Prussia, produces approximately 1,000,000 tons of the output credited to the nonsyndicated mines. In 1907 a law was enacted reserving all future coal discoveries to the State instead of allowing their exploitation by the discoverer. Some purchases of mines were made and other authorized, and the Prussian Diet appropriated $13,000,000 for improving and working the mines bought by the State.

FAILURE OF AN EFFORT TO REGULATE.

A further step was the unsuccessful attempt of the Government to obtain the Hibernia Coal Company, which was one of the leading syndicated collieries. The paternal policy adopted was for the Government to acquire a friendly interest in the coal syndicate as a partner or stockholder for the benefit of the public. The state employed the Dresden bank to buy up the shares of the Hibernia mine, so that it might become the controlling owner. The bank got stock to the amount of 27,500,000 marks, and the state then offered to take over the works, guaranteeing 8 per cent by means of 3 per cent consols. This offer was refused by the executive committee of the company, and in order to maintain control the committee, with some of the banks, formed the "Association of Hibernia Shareholders," raised the capital by 5,000,000 marks and bought all the extra shares, so that the Government shares would have little voice in the management and would be unable to determine the policy of the colliery as one of the constituents of the coal syndicate. The Government sought to overcome this device and appealed to the courts to uphold its rights. But it was nonsuited by the "Reichsgericht," the supreme court of the Empire, and the plan was a complete failure. With the purchase policy of the state thwarted, the next governmental move may be toward nationalization of the coal mines.

THE COKE SYNDICATE.

The coke syndicate is so closely allied with the coal syndicate that it needs only a brief description. The first steps in its formation were taken in 1882, when a combination known as the "Coke Union" was formed in the Dortmund district for the purpose of fixing the prices. This went to pieces in 1884, was reconstituted in 1885, and in the following year took in the cannel-coal mines, expressly including the regulation and restriction of production among its objects. Out of this union grew the coke syndicate which was formed in 1890. Like the coal syndicate, it has a small capital, the shares of which are transferable only by consent of the association. It deals with the coke works and mine owners on the basis of a permanent agreement. In 1895 it entered into a working agreement with the Westphalian coal syndicate, under which the latter handed over the entire sale of its coking coal for the use of private coke works to the former. On its part the coke syndicate is bound not to buy coal from any non-syndicated mine without the permission of the coal syndicate. The executive committee of the coal syndicate is represented on the supervising committee of the coke syndicate. In operation the coal and coke syndicates are generally classed together, sharing public opprobrium at periods and at other times receiving recognition of services rendered to the various industries.

IRON AND STEEL INDUSTRY NOT DEPENDENT.

In relation to the coal and coke syndicates, it can not be said that the iron and steel industry as a whole is at the mercy of these combinations, since all the large concerns possess collieries of their own. This movement started as soon as the dominating influence of the coal syndicate became apparent. All the leading blast furnaces and foundries either bought collieries outright or secured a share in them. In this way they became constituent members of the syndicate, reserving the coal needed for their own use and sharing in the profits of the syndicate's sales. Their advantage over competitors was that they were sure of their own supply of fuel, while in the periods of very active demand the competitors had to pay the syndicate prices and frequently even then could not obtain sufficient fuel. Nevertheless the iron and steel works which are members of the coal syndicate do not enjoy an unmixed advantage, because the customers for their half-finished products—that is, the finishing works—in periods of high prices and scarcity of coal are restricted in their own purchases, and the market for the half-finished products is proportionately affected.

A GROUP OF SYNDICATES.

The by-products syndicates were organized to secure the full utility of the various products of ammonia, benzol, and tar, there being a separate association for each of these products. Sulphate of ammonia competes with Chilean nitrates as a fertilizer. These by-products are closely controlled by the superior syndicates, are profitable, and are an element of economic saving in the manufacturing processes.

Owing to recent events the raw-iron syndicates can not now be considered as a fixed factor in the production of iron and steel, yet it can not be said that they are entirely eliminated. Their rise was coincident with the development of the coal and coke syndicates. They were divided into geographical groups—the Rhenish-Westphalian, commonly known as the "Dusseldorf;" the Lorraine-Luxemburg; the Siegen; and the Upper Silesian Syndicate. In their general operations, though the organization was somewhat loose, this group of syndicates might be considered as a single body. Some difference of detail existed among them in regard to the handling of the products for the home market and for export, and within their own spheres the regulations for internal management differed, a limited field being left to each one for independent action. They were united in one purpose, which was declared to be to supply all the raw iron needed by the German home market; also they were willing to help supply the home market of other countries.

RAW-IRON COMBINATIONS.

The raw-iron syndicates had more difficulties than other combinations. The economic process by which the gas from the blast furnaces is utilized in driving engines, which has been one of the means of the rapid advance of the German iron and steel industry, was a source of trouble. In the Dortmund district, where the population is dense, some of the mills supply gas also to private consumers. The real difficulty, however, appears to have been the inability of the group of syndicates to draw to themselves all competitors. The Eisenwerks Kraft of Stettin, a very powerful concern with large resources, was a disturbing factor. It was able to maintain its market in the face of the combined efforts of the syndicates. The blast furnaces at Stettin on the Baltic not only have the advantage of water transportation for the Swedish ores, which are chiefly used, but also are able to use English coal, not being dependent on the coal fields of Upper Silesia to which they are tributary.

The swift changes in the iron and steel trade which marked the depression that began in the fall of 1907 were most pronounced in the decreased demand for raw iron. At the beginning of 1908 the raw-iron syndicates had discouragingly small orders on their books for the new year. The situation grew worse and attempts to prop up prices failed. It was claimed that while a drop could not be avoided if the Stettin works were willing to cooperate, the fall could be arrested until general improvement in the trade both at home and abroad should return. Efforts were therefore made to secure the cooperation of the Eisenwerk Kraft.

ATTEMPT TO FORM NEW SYNDICATE.

Private conferences were held but without result, and in June, 1908, the four raw-iron syndicates addressed a joint letter to the Eisenwerk Kraft saying, in substance, that the situation could only be saved by the formation of a new syndicate, which would only be possible if all the large raw-iron producers joined it. The Eisenwerk Kraft responded briefly that their situation required special protection against foreign intrusion, and that they could only be sure of this by maintaining their freedom of action. However, they were willing to join a special syndicate limited to f[illegible] iron, provided their allotment was placed at 160,000 tons [illegible] division [illegible] the territory which the group of raw-iron syndi[illegible] ad[illegible] altered so as to give them a larger share in [illegible] specified.

The group of syndicates replied in effect t[illegible] redivision of the territory was not based on pr[illegible] the market; that the limitation of a syndicate [illegible]

not practicable; and that, since the leading purpose of the four syndicates was to prevent foreign intrusion, the Eisenwerk Kraft would best guard itself from foreign competition by joining them. The reply made in September was to reiterate the objections of the Stettin company. Thereupon the four raw-iron syndicates declared their agreement off after December 31, 1908, and that all the members were at liberty to sell as they pleased.

RESULT OF FREE COMPETITION.

This meant free competition. Though the existing agreement did not terminate until the end of the year, offerings were made at once at lower prices, and the downward tendency was accentuated, so that raw iron fell in the Rhenish-Westphalian district from 72 ($17.28) to 55 marks ($13.20) a ton, and the same terms were offered to the rolling mills at Aix-la-Chapelle, notwithstanding added cost of transportation to that district. In the Lorraine-Luxemburg district prices dropped until in November it was claimed that foundry pig iron was selling below actual cost to manufacture by at least 4 marks, or 96 cents. The Luxemburg mills offered the Belgian works at Liege foundry pig iron at 43 marks ($10.32) per ton. Large contracts extending through the year 1909 were made by most of the raw-iron producers at low prices.

The Siegen Syndicate succeeded in forming a sales association which it was expected would prevent further demoralization in 1909, and the Lorraine-Luxemburg Works arrived at an understanding which it was hoped would enable them to hold together during the period from January to July. The Rhenish-Westphalian Syndicate, however, sees the end of the year approach without agreement, and the opinion among those best informed is that this organization can not be reconstituted. There are alleged to be certain circumstances kept from the public which are the basis of this opinion.

The Eisenwerk Kraft up to the present has shown no intention of changing its attitude. In the present demoralized condition it is not possible to predict the complete effect of the dissolution of the raw-iron syndicates on other combinations in the iron and steel industry.

THE POWERFUL STEEL SYNDICATE.

[illegible]ahlwerks Verband" (steel works union, or steel syndicate), [illegible]upies an intermediate position between the coal syndicate [illegible]anufacturers of finished products, is not directly affected [illegible]n situation, since its organization extends until June [illegible] cannot, however, remain entirely unaffected. The steel [illegible] in many respects the most powerful and the most com[illegible]zed of all the groups of affiliated industries. It has

31 members, of whom nearly one-half are in the Dortmund district, and its individual members are known to the trade the world over. Some account of its organization and methods is of general interest. The administration and executive headquarters are at Dusseldorf, where a large staff of accountants and other employees is maintained.

The policy of the association is controlled by the general assembly, which is composed of all the members. There is an administrative council, but the practical work is carried on by an executive committee. The base of the contract among the members—that is, the participation—is for each 1,000 tons of products, which are described in detail. The contract covers all that the members of the syndicate produce of the following articles: (*a*) Raw steel (ingots); (*b*) puddle loops; (*c*) finished products derived from raw steel and puddle loops.

The products manufactured by members by means of articles they have purchased or made themselves are divided in products "A" and "B." Products "A" are subdivided as follows: (*a*) Half-products group—blooms and slabs, raw and worked billets, plates, puddle loops; (*b*) railway-material group—rails for railway beams and other rails, cross rails, etc.; (*c*) form-iron group. Products "B" are divided into: (*a*) Merchant products—bar and flat iron, sheets, etc.; (*b*) machine group; (*c*) cast-iron group; (*d*) tubes group; (*e*) molds and foundry pieces.

REGULATIONS FOR SALE OF PRODUCTS.

Products "A" are syndicated and products "B" are not. In nontechnical terms it may be said that the syndicated products cover, first, half-finished stuff, raw ingots, rolled ingots, girders, slabs, billets, etc.; second, form or shaped bar iron; and third, railway material, both rails and superstructure. The nonsyndicated products include bar iron, sheets, tubes, railway axles, wheels, etc.

Among the provisions of the agreement is one authorizing the executive committee to buy and sell "A" products of steel works which are not members of the syndicate. It is also authorized, if the buyers demand, to deliver along with "A" products minor material and "B" products bought of syndicated mills, although these mills are not part of the steel syndicate, when the syndicated works do not deliver the products in question, or when the price is too high. Transactions of this kind must be reported to the General Assembly.

ADVANTAGES AND DISADVANTAGES RECONCILED.

The syndicate is considered as the direct purchaser from the members, and the purchase price is determined in accordance with the provisions of a price table which is carefully worked out. Account *is taken* of the advantages or disadvantages which the geographical

situation of each plant has, and the prices are fixed so as to equalize these disadvantages and advantages, a special table fixing the relative transportation facilities. The advantages and disadvantages are computed separately for the domestic and the foreign markets. They are calculated for each member according to the deliveries made for account of the syndicate, and are divided between the domestic and the foreign in the same proportion that the total deliveries are effected for account of the syndicate.

For the sale of form iron in southern Germany the syndicate is required to demand a price 3 marks (72 cents) above the price per ton at Diedenhofen, which is the central point of the Dortmund district. Specific delimitation is made of the territory which is considered as within southern Germany. For the sale of form iron in the zone to the north of this territory the syndicate requires 1.50 marks (36 cents) per ton above the price at Diedenhofen. The boundaries of this intermediate zone are given in detail. The addition of this extra price of 3 marks and 1.50 marks is apportioned among the members in southern Germany according to their figures of participation in form iron. During the existence of the agreement regarding the scale price list it can be modified only by a majority of the General Assembly, three-fourths of the members present voting in favor.

RESERVE TO SUSTAIN FOREIGN SALES.

A statement of considerable importance is embodied in the provision that in the interest of all the members there shall be constituted a reserve which in case of necessity shall serve especially to sustain foreign sales. For this purpose a tax of 1 per cent upon the deliveries made is held back and turned into the fund especially administered by the executive committee. Without the authorization of the General Assembly the members shall neither sell nor hire either in total or in part to nonmembers of the syndicate for the manufacture of products "A" and "B." "For the purpose of defending the common interest" the executive committee can, upon the direction of the General Assembly, make "protective agreements" with other syndicates.

The operations of the steel syndicates may be exhibited in a summary of the fiscal year which ended March 31, 1908. During that year the production and distribution of the works composing the association was:

Product.	Inland.	Foreign.	Total.
	Tons.	*Tons.*	*Tons.*
Half stuff	1,093,872	258.001	1,456,445
Railway material	1,587,724	711,438	2,368,658
Form iron	1,176,136	424,666	1,601,895
Total	3,857,732	1,394,105	5,426,998

The quantity of half-finished products, raw steel weight, was 338,-833 tons less than the output of the previous year. Of the total, 81.54 per cent was inland and 18.46 per cent foreign.

In railway material a gain of 335,421 tons was made. Of this material 68.58 per cent was taken by the home market, and 31.42 per cent by the foreign market.

The form iron product fell 326,337 tons below that of the previous year. Of this production 73.42 per cent was taken by the home market, and 26.58 per cent is credited to the exports.

The total production of class "A" products was 11 per cent below the participation figures; that is, below the quantities which the members would have been allowed to market had they been able to obtain customers. The figures of participation under the new contract assign 6,054,084 tons to syndicated and 5,817,535 tons to nonsyndicated products.

NONSYNDICATED PRODUCTS.

In the groups of nonsyndicated products bar iron furnished the principal article. The figures of participation for it were increased under the new contract from 2,590,000 to 3,300,000 tons, while half-finished products were reduced from 2,020,000 to 1,350,000 tons. These figures of participation are significant of the change going on in the iron and steel industry. The field has been divided into two hostile camps. One was the "pure" rolling mills, so called, which buy their billets and similar material. The other was the "Hütten" or mixed works, which make their own billets and manufacture bars, rods, etc. The tendency is for the "pure" rolling mills to combine with the works producing half-finished goods and economic causes contribute strongly to the movement.

The increase in the bar-iron product allotted to the members of the syndicate reflects this tendency and the possible disappearance of the hostile camps through the absorption of the "pure" rolling mills by the mixed works.

INTERMEDIARY IN CONTRACTS.

The Stahlwerks-Verband is the intermediary for important contracts, not only with private consumers, but with foreign governments. It is also the negotiator with the German Government and the different state governments. In its report published in October of the present year the Stahlwerks-Verban criticises the railway administrations of the different States for not helping the iron and steel industry by calling for material more liberally in the periods of depression. Existing contracts made with the Prussian Government in 1907, and with other States in the present year, are for the delivery of steel rails at 120 marks ($28.80) per ton. The

Verband complains that the new contracts only afford a partial compensation for the increase in cost prices in all branches of the business, while they do not make up the loss suffered by fulfilling their home contracts during the general rise in 1907 and preceding years as compared with international market prices. It is claimed that this loss was of greater consequence since these home deliveries were mostly made under former low prices, and they were forced by the different state railway administrations in a way to deprive the Verband of its profits in the world markets, because when the foreign demand at high prices was in full swing the Verband could not fully meet it, since its members were forced to supply the home railways at lower rates. It is questionable, however, whether this criticism will be borne out during the present period of depression, since the different States show a disposition to help the iron and steel industries, and the existing contracts for rails at 120 marks were made with a full knowledge of the falling tendencies of the market.

EXPORT POLICY AND BOUNTY.

The export policy of the syndicates is so essential a feature of the whole system that it requires a brief description. The practice appears to be that the bounty is not paid on the consumption of their own products to the different syndicate members, but rather to the consumers; that is, the reduced rates are in the nature of a premium to the buyers. In 1902, when the recovery was beginning from the severe depression which had followed the boom of 1900, the Westphalian Coal Syndicate and its allied combinations and the raw-iron, half-finished iron and steel, and girders industries established a clearing house with headquarters at Düsseldorf for the special purpose of arranging the premiums on exports. The general principle was laid down that the export premium must, as a rule, not exceed the difference between the foreign and the inland prices, with a reduction of 1 per cent of the premium to cover the working expenses. The application of the principle has become very intricate, and it is doubtful if the members themselves fully understand the workings of the Düsseldorf Clearing House. However, they are clear that exports are promoted by granting premiums, and numerous instances are given of the amounts of these premiums.

The payment of the bounties is worked out somewhat as follows: The coal syndicate pays a bounty to the members of the raw-iron syndicates who own no collieries and who as customers help to work off the coal produced; the members of the steel syndicate, who produce no raw material of their own and who purchase from the raw-iron syndicates, in turn become entitled to a bounty from them, and the process is continued through the multifarious finishing industries which are buyers of the half-finished products of the steel syndicate.

During the active period from 1905 to 1908 the maximum bounty paid per ton on coal was 36 cents; on raw iron, exclusive of coal bounty, 60 cents; half finished goods, inclusive of bounty on coal and raw iron, $3.60; girders of all kinds, inclusive of bounty on coal and raw iron, $7.80. These bounties are reduced, discontinued and restored, and modified from time to time according to the state of the home and foreign markets, but the system is too intricate to be followed in all its details.

EFFECT OF THE SYSTEM.

The effect of this export system is, to some extent, a matter of opinion. In substance it is defended on the ground that while foreign sales are frequently made below cost prices they are not below the actual cost, the general average being made up from the total receipts of both the home and the foreign markets. Nevertheless, in some cases, in order to decrease the overproduction, or to protect the foreign market, it is admitted that sales are made below actual cost. Some anomalous instances are shown of the policy, as in the case of semimanufactured raw material, which is exported and then reimported at a lower price than the home consumer can obtain. In general the objection made by the finishing industries is that by shipping what should be their raw material abroad at lower prices than it is sold for at home, their international competitors are able to build up business at their expense, and that one class of home industries therefore suffers seriously by the policy. In its broad aspect there is no disposition to deny the syndicates the credit for preventing excessive rises during boom periods, and equally for preventing rapid falls in periods of depression. This is called the "leveling process" and is exploited by all the syndicates in justification of their methods. Since the present depression it is pointed out that the fall in the prices of articles not included in the export-bounty arrangement has been far more rapid than with those included, and numerous examples confirm this claim. In further illustration it is cited that the establishments which expected to profit by the demoralization resulting from the impending dissolution of the raw-iron syndicates found their own products reduced in greater proportion.

TENDENCY TOWARD FURTHER CENTRALIZATION.

In the general syndication of iron and steel works there are some economic tendencies and counter tendencies the result of which can not be anticipated. While the syndicates stoutly uphold the system as applied to their customers, they do not take the same view as applied to themselves. This was shown in the unwillingness of the large blast furnaces and rolling mills to be at the mercy of the coal syndicate when they met the situation by buying coal mines of their own.

If all other conditions were favorable for the establishment of new iron and steel industries no considerable amount of German capital could be induced to go into them now unless first assured that the sources of supply of raw material were secured by the ownership or interest in collieries. The unquestioned tendency at present is toward further centralization, as illustrated in the troubles of the raw iron syndicate and in the changing proportions of nonsyndicated and syndicated products in the Stahlwerks-Verband. Each successive syndicate seeks to protect itself as far as possible in the matter of raw material or semiraw material. Naturally there is a limit to this movement, it becoming more and more difficult for the industrial establishments to control their raw material as the stages in the manufacture of the finished products advance.

POPULARITY OF THE SYSTEM.

In spite of a constant stream of criticism and interrogation it can not be said that as a whole the German people are opposed to the system which is so thoroughly a part of their industrial development. Their fondness for minute organization finds full scope in the syndication, and some times their ingenuity proves superior to what seems to be insuperable natural possibilities. Generally, it may be said, that both Government and people are committed to the policy of securing a proportion of the export trade for all industries, usually one-third. Often the objection to the foreign prices is not that they are lower than home prices, but that the margin is too great.

The attitude of the Government itself certainly can not be considered antagonistic, though it might be described as neutral. In 1903 the Imperial Reichstag instituted an inquiry into the kartells or syndicates, and this inquiry has been continued at intervals up to the present time. The testimony has furnished much useful information as to the various combinations, and unquestionably has exposed abuses. Some of the testimony given by the syndicates themselves is treated as confidential and does not reach the public, though it may be presumed to have influence on the nonintervention course of the Government. The attitude seems to be that publicity should be encouraged and abuses, if they exist, be exposed, so that a corrective remedy may be found. While great conservation is shown in applying remedies, the publicity without doubt has caused some of the abuses and anomalies of the system to be corrected.

ATTITUDE OF THE GOVERNMENT.

The nonaction of the Imperial Government and of the state governments is not to be taken as a fixed and permanent policy. It is considered possible that one of the ultimate results will be the absorption of the greatest syndicates controlling raw material by the Govern-

ment itself. This relates to the coal syndicate and more immediately concerns the Kingdom of Prussia. The agitation, which can hardly yet be called a movement, for the nationalization of the coal mines is to be judged by considerations which are not purely economic or commercial, and which do not exist in other countries. A highly centralized and paternal government that already has taken to itself many public utilities and has nationalized the railways may in time nationalize the coal mines and insure free competition to consumers under such conditions as the state may care to determine. A political motive enters such prospective action. The Social Democratic party in Germany, and particularly in Prussia, is in constant antagonism to the Government, urging measures which would strengthen its own power if carried out under a regimen of social democracy. The Government therefore protects itself and seeks to weaken its opponent by taking to itself these agencies of state monopolies. Nationalization of the coal mines is held by many persons to be the inevitable sequel of the ownership of the means of transportation by the Government.

DIVISION OF FOREIGN MARKETS.

In striving for the international markets, the German iron and steel manufacturers are quite willing to expand the system of syndication. At the present time there are international syndicates in several products. The German coal and coke syndicates have an arrangement with the Belgian coke syndicate by which French territory is divided between them, and occasionally the syndicate in one country will sell to the other coke for delivery in France. Some of the international syndicates are little more than price conventions, while others relate to the partition of the territory, The intangible but potent international rail syndicate counts in Germany as a leading member. It is understood that the rail syndicate includes the American, British, German, French, Belgian, and Spanish mills. Under it Germany has special privileges in the markets of Sweden, Norway, and Denmark. It also keeps out of the United States market, while dividing with the mills of the United States and with Great Britain, France, and Belgium, the South American territory.

The tube syndicate keeps it out of American territory in the sale of gas pipes, while under the rolled-wire syndicate a division of the territory is obtained. Under the tube syndicate a division of the territory is also obtained. Under the tube-syndicate arrangement the German works keep out of the French territory, in compensation for which the French leave Belgium, Switzerland, and Holland to Germany.

While favoring the principle of international syndicates, the German manufacturer, as a rule, is not willing to join them unless assured that the German industry obtains its full share of present *markets without* prejudice to further development.

TRANSPORTATION AND FREIGHT RATES.

The development of the German iron and steel industry, particularly in relation to foreign trade, must be studied in connection with the means of transportation and the government measures relating thereto. The waterways are of great natural utility, the rivers being supplemented by canals. Since the Government owns and operates the railways, there is no disposition to consider the rail and water routes as antagonistic, hardly as competitors. Instead they are made to serve each other. In the construction of canals, joining the waterways and railways, and in enlarging the means of commercial intercourse a definite policy is kept in view.

The rivers of Germany, emptying as they do into the North Sea and into the Baltic, are of much benefit to foreign trade, both import and export. The Baltic has the Oder, with Stettin near its mouth, though the utility of this river as a highway of commerce is not equal to that of other rivers, especially the Elbe and the Rhine. The Rhine with its tributaries taps great coal and iron districts, and in addition to its value for ordinary traffic has special advantages for the transport of fuel. Its importance is seen at the twin ports of Duisburg-Ruhront, which are located at the mouth of the River Ruhr. This is the greatest inland port of Europe. Its traffic, including the tributary port of Hochfeld, in 1907 amounted to 16,095,000 tons of ordinary freight and 8,558,400 tons of coal. In 1906 the movement of merchandise products upstream, or toward the interior, amounted to 7,318,500; and downstream or seaward to 7,267,000 tons. The quantity of coal handled affords an explanation of the value of this means of navigation to the Ruhr coal basin. Nevertheless, much of the raw material for the blast furnaces is transported entirely by railway, the saving in cost of handling and rehandling offsetting the natural cheapness of the waterway.

RELATION OF TRANSPORTATION TO IRON AND STEEL TRADE.

The most important artificial waterway that taps the Ruhr basin is the Ems Canal, which extends from the Rhine across the Lippe to the North Sea, with a branch to Dortmund. This branch, known as the "Dortmund-Ems Canal," in particular serves the blast furnaces of this region in obtaining their Swedish and Spanish ores, some of which import from over-seas 60 per cent of the ore they use. The Luxemburg-Lorraine district is able to benefit by the Rhine to some extent through the Moselle River and canal system in receiving coal and in forwarding ore. The industrial development is con-

trolled by railway rates which the Government determines, and since they cover all sections, while the waterways do not, they are taken as the basis for the present analysis of the relation the transportation facilities bear to the iron and steel trade.

In fixing the transportation rates ore is treated as primary raw material, the same as agricultural products, and is therefore given the lowest rates in the freight schedules. This treatment has been extended to the ores from the Meurthe-Moselle district in France. Coal and coke also are raw material. Iron and steel products come under special tariffs which have been devised by the Government on the principle of encouraging the manufacturing industries. There are two features to these tariffs. These are the discrimination in favor of goods for export, with a further discrimination according to the destination of the goods, one schedule prevailing for European countries and another for distant over-seas countries—that is, America, Asia, Africa, etc. The foreign-trade schedules from various interior points are known as "Ausnahmetarif" or exceptional tariffs.

CLASSIFICATION OF TARIFF RATES.

Iron and steel products are divided into three special tariffs or classes. The first includes chiefly finished products, steel manufactures of all kinds and manufactures of steel into which other material enters; the second, merchant bar iron, form iron, plate and sheet iron, tubes and pipes, parts of columns, bars and shaped iron for bridges, rails, sleepers (ties), thrashing machines, parts of locomotives and cars for railways, loop-iron rods and rivets, etc.; the third, raw iron of all kinds, pig iron, old iron and steel, steel plows, traction engines, boilers, pumps, railway and street locomotives, etc.

In view of the necessity of knowing the different classes of products included under the three special tariffs when determining the freight rates for the various articles, the official tariff classifications of the state railways are given below:

SPECIAL TARIFF I.

Iron and steel.—Articles of iron and steel of all kinds; also covered and combined with other materials (precious metals excepted), if they are not specially mentioned among articles in iron or steel, classified under special tariffs II and III; machinery and utensils of all kinds in iron or steel, put together or not, included.

SPECIAL TARIFF II.

Iron and steel.—Articles in iron or steel, galvanized, foliated, or covered with lead.

1. Iron alloys not specially mentioned under special tariff III.
2. Iron and steel in bars and worked up iron and steel of all kinds.
3. Plates and sheets of all kinds.

4. Pipes in iron, columns and poles of all kinds, of whatever use, props and supports of open air conveyance of all kinds, including accessories in iron necessary for setting up.

5. Articles of construction in iron composed of posts, plates, beams, and joists in iron, such as pieces of bridges, frames of roofs, halls, veranda hand rails, stairs, frames for furnaces, including all pieces for setting up, for fixing or for foundation, necessary for the mounting and belonging to the same lading.

6. Rails, crossbeams, switches, and crossings, turning platforms, and other pieces necessary for the superstructure of railways of all kinds.

7. Pieces of locomotives and railway carriages of all kinds, except the boilers, the machines, the motors, and their detached pieces.

8. Laminated thread in iron or steel or coppered, in circles or bundles, not packed, or packed in paper.

9. Wrought articles in cast, forged, or rolled iron:

(*a*) Of 100 to 2,000 kilos per rough or rough-draw piece not or partially packed.

(*b*) Of more than 2,000 kilos without distinction as to the degree of finishing or package.

10. Rivets.

11. Rough horseshoe and fire bars not packed.

12. Steel emery (molecule of cast iron) or iron and steel granulated paste or powder materials for packing, grinding, or sawing.

13. Steel balls unpolished.

SPECIAL TARIFF III.

Iron and steel.—Articles of iron and steel, viz:

1. (*a*) Pig iron of all kinds.

(*b*) Alloys of iron, such as ferromanganese, forrosilicium, forrochrome, etc., so far as they are obtained by means of blast furnaces.

(*c*) Iron and steel reheated and melted, steel in skillet slabs, block or ingots.

(*d*) Half-finished products rough hewed with hammers or rolling-mill products, such as reheated iron in parcels, in blooms, puddled iron, cake, iron plates for tongues.

2. Iron and steel, old. Are considered as old iron or steel, pieces which can no more be used for their original destination.

Pieces in iron or steel which have been used, but are not unfit for use, can not be considered as old steeel or iron, but are to be classified according to their exterior form, viz, pipes, wheels, etc.

If in a shipment of old iron or steel, there is a small weight of pieces, not unfit for use, yet the whole shipment is to be taxed as old iron and steel.

3. Iron and steel (waste of), scrap iron and steel, are to be classified under this denomination: Waste of iron or steel thread, turnings, chips, filings, shavings of iron or steel, ends of splints, rails, cross-beams, pieces of plates, and all other kind of broken pieces.

4. Pieces for superstructure of railways used already as mentioned under No. 6 of the special tariff III.

5. Steam plows, thrashing machines, horsepower machines, straw presses, straw binders, straw elevators, straw-cutting machines, chaff cutters, machines for cleaning of corn, graters, harrows, pumps, which have been in use.

6. Traveling steam engines and road locomotives having been used.

APPLICATION OF SPECIAL TARIFFS.

The application of these special tariffs can be seen from a series of rate tables giving the different points of shipment and receipt and

the distance between them. In the foreign trade it is not practicable to limit the reduced rate to German ports, since Rotterdam and Antwerp offer advantages, and shipments are made through them in connection with the railways of Belgium and Holland. In the case of Rotterdam, however, the water rate is the controlling one, since the Rhine empties into the sea there.

Antwerp is a convenient shipping point, especially for Aix-la-Chappelle and the Lorraine-Luxemburg district. The Luxemburg and Belgian State railways follow the practice of the German lines in making transit or export rates. In fixing the schedules the minimum quantity is 10,000 kilograms or 10 tons, this being the carload rate. The following exhibits the freight cost of raw material between several important points, the unit of cost given being 10 miles:

	Distance.	Rate per 10 tons.
Coal and coke:	*Miles.*	
Essen to Luxemburg	182	$17.76
Bochum to Luxemburg	194	18.00
Dortmund to Luxemburg	206	19.20
Iron ore:		
Luxemburg to Bochum	194	12.72
Luxemburg to Dortmund	206	12.72
Rotterdam to Duisburg	131	12.72
Water rate	.....	5.40

For coal from Duisburg-Ruhrort to Antwerp, 135 miles, the railway transit or export rate would be $15.47, or $1.55 per ton; but in view of the Rhine transportation to the sea shipments of this kind are not frequent. The water rate would be 52 cents per ton. Similarly the rail freight on iron ore from Rotterdam to Ruhrort, 131 miles, would be $1.27 per ton as against 54 cents by water. There is a special graduated tariff covering all imports under which the charge for transporting 100 kilograms (220 pounds) 500 kilometers (310 miles) is 70 pfennig (17 cents) or about $1.70 per ton. Shorter distances are graduated proportionately.

Aix-la-Chapelle, which imports ore both from abroad and from the Luxemburg district, pays 56 cents a ton for the railway freight on Spanish ore delivered free Rhine harbor at Cologne or Ruhrort, 96 cents on Luxemburg and 72 cents on deliveries from the Siegen district. Swedish ore freight via Rotterdam and the Meuse ship canal ranges from $1.68 to $1.92 and via Ruhrort or Cologne $2.04 per ton. The freight on coal and coke from Bochum to Aix is 84 cents and from other Westphalian collieries 72 cents per ton.

The rates for iron and steel products under the three classifications, or special tariffs, and the difference in the local rate and also the differences between the rates for other European countries, and for over-seas countries, outside of Europe, can be seen from the tables elow, which give the rates for 10-carload lots.

TRANSIT AND LOCAL RATES VIA ANTWERP.

	Distance.	First class.	Second class.	Third class.
Cologne to Antwerp:	*Miles.*			
Local	132	$26.29	$22.17	$16.00
Transit	133	19.36	13.26	11.40
Düsseldorf to Antwerp:				
Local	115	24.41	20.67	13.72
Transit	117	17.43	12.06	10.59

TRANSIT AND LOCAL RATES VIA GERMAN PORTS.

	Distance.	First class.	Second class.	Third class.
To other European countries.				
Cologne to Hamburg:	*Miles.*			
Local	264	$32.92	$25.68	$24.24
Transit	.....	25.68	13.92	.....
Cologne to Bremen:				
Local	204	25.20	20.40	17.26
Transit	.....	.....	16.96	16.96
Düsseldorf to Bremen:				
Local	181	22.56	18.24	16.96
Transit	.....	.....	14.64	14.64
To countries beyond Europe (transit).				
Cologne to Hamburg	.....	.....	20.40	20.40
Cologne to Bremen	.....	20.40	12.72	.....
Düsseldorf to Hamburg	.....	23.52	12.96	.....
Düsseldorf to Bremen	.....	18.24	11.28	.....

WORKING OF THE SYSTEM.

Under the above tariffs the working of the system may be shown in a different way, taking 10 tons of steel rails as the unit and selecting other shipping points. From the steel mills at Dortmund to Hamburg the rate for steel rails would be 54 marks ($12.96 or $1.30 per ton) for other European countries, 70 marks ($16.80 or $1.68 per ton) for countries beyond Europe, and 87 marks ($20.88 or $2.09 per ton) for Hamburg itself; that is, for domestic consumption. By way of Antwerp the transit rate would be 80.20 francs ($15.48 or $1.55 per ton). For illustration, finished and highly finished products, Solingen, which is the center of the hardware and cutlery industry, is taken. The freight cost for export from Solingen to Antwerp would be 103.80 francs ($20.03) for goods under special tariff I, and 70.90 francs ($14.58) for goods under special tariff II, as against a local rate of 130.10 francs ($19.41) and 100.60 francs ($19.41), respectively. From Solingen to Hamburg the export rate would be under special tariff I, 124 marks ($29.76); tariff II, 100 marks ($24); tariff III, 94 marks ($22.56). In addition to the general rates, iron and steel material for the German shipbuilding industry is given a special drawback from the point of manufacture to the port to which shipped.

FURTHER ILLUSTRATIONS.

The cost of transportation also may be illustrated by examples outside the Dortmund district. Taking the Duedlingen works in the Luxemburg section as an example, the transit rates would be as follows on two classes of leading products in 10-ton lots:

Duedlingen to Antwerp:	
Pig iron	$14.96
Manufactured iron	19.99
Duedlingen to Rotterdam:	
Pig iron	17.28
Manufactured iron	21.84

From this point to Dusseldorf the rate would be $18.24 on pig iron and $27.36 on manufactured iron. Shipments of this kind, however, are not often made.

On some of its chief products the Aix-la-Chapelle district pays the following 10-ton carload rates:

Aix-la-Chapelle to Hamburg, Bremen, and other German ports for export to countries beyond Europe:	
Pig iron	$19.20
Construction iron	19.68–20.40
Aix-la-Chapelle to European countries via German ports:	
Pig iron	27.36
Construction iron	27.60
Tools, implements, stoves, finished products, etc	38.40

Iron to foreign ports would have these rates:

Aix-la-Chapelle to Antwerp:	
Transit	$11.52
Local	19.60
Aix-la-Chapelle to Rotterdam:	
Transit	16.80
Local	23.80

Cast-iron tubes, which are among the chief manufactures of Aix-la-Chapelle, have an export rate of $13.44 via Antwerp and $15.60 via Rotterdam. Aix-la-Chapelle is on no river or canal, but it reaches the Maestricht Canal with the outlet through the Meuse River by a railway haul of 20 miles. It is also within 15 miles of the Belgian border, and therefore comes within the rate sphere of the Belgian state railways.

In connection with this branch of the subject it should be stated that the Belgian steel works at Liege have a special tariff of $7.33 per 10-ton lot on shipments of crude iron and steel products from Liege to Antwerp.

The transportation rates of the German railways are modified from time to time; but the changes are not radical, unless it can be shown that a lower rate than the current one will insure greater foreign trade. Then the change is apt to be made for the Government recognizes the importance of transportation rates in securing and maintaining markets abroad.

FOREIGN MARKETS.

In no class of merchandise is the general policy of securing foreign trade so harmoniously observed by government and by private companies and individuals as in the iron and steel industry. This is made clear from the transportation rates. It also has been indicated in connection with the syndicates, the foreign market being the chief ground of their justification for selling goods abroad lower than at home. The economic and commercial tendencies appear from various statistical exhibits, though the changes in the tariff classification which went into effect in 1906 make complete comparisons impracticable.

The imports and exports of iron since 1900 are summarized as follows:

Year.	Imports.	Exports.	Excess of exports.	Year.	Imports.	Exports.	Excess of exports.
	Tons.	*Tons.*	*Tons.*		*Tons.*	*Tons.*	*Tons.*
1900	983,112	1,548,558	1,548,558	1906	690,076	3,666,774	2,976,698
1902	268,918	3,309,007	3,040,089	1907	813,349	3,452,402	2,639,053

In values the excess of iron exports over imports was 342,100,000 marks ($81,491,200) in 1900 and 634,440,000 marks ($150,996,720) in 1907. The total value of the exports in 1907 was 750,010,000 marks ($178,502,380) as against 479,810,000 marks ($114,194,780) in 1900.

VARIATIONS IN IMPORTS AND EXPORTS.

The imports of raw iron increased from 409,082 to 443,624 tons, while the exports decreased from 479,772 to 275,176 tons, so that the excess of exports over imports may be taken in some measure as an index of the relative trade in finished products. What has been happening in the last five years is the decrease in the exports of raw and half-finished products, the stationary condition of rolling-mill products, and the increase of finished products. In 1903 the exports of raw iron, old iron, and half-finished products were 1,165,000 tons, while in 1907 they only amounted to 623,000 tons. In 1907 the export of rolling-mill products was 1,708,000 as against 1,732,000 tons in 1903; but iron and steel manufactures rose from 547,000 in 1903 to 1,078,000 tons in 1907, and engines and machines from 248,000 in 1903 to 233,000 tons in 1907. In 1900 the value of the exports of crude iron and steel manufactures was 139,100,000 marks

($33,105,800), and of fine manufactures 71,100,000 marks ($16,921,-800), while in 1907 the figures were, respectively, 156,200,000 marks ($37,175,600) and 85,500,000 marks ($20,349,000). Loop-iron products were in 1900 4,000,000 marks ($952,000), and in 1907 23,400,000 marks ($5,579,200); rolled-wire products in 1900, 29,900,000 marks ($7,116,700); 1907, 54,300,000 marks ($12,923,400).

The exports of loop iron have been mainly to Great Britain, which takes 50 per cent of the value and quantity of this product. In exchange Great Britain is Germany's chief source of supply for raw iron, Sweden coming next. Some raw iron is also exported from Germany to Belgium.

GERMANY'S CHIEF CUSTOMERS.

In wire rods the chief customers were Japan and Great Britain, while fish plates and ties were widely distributed, the leading buyers being the Argentine Republic, Turkey in Asia, and Switzerland.

In steel rails, the exports of which doubled in the years from 1904 to 1907, South America was among the best customers. The Argentine Republic alone in 1907 took more than any two other countries, 71,000 tons. Mexico was a buyer to the quantity of 23,700 tons. In the Orient Japan was the leading customer, taking 36,700 tons. In Europe most of Germany's continental neighbors are customers. The shipments to Holland amounted to 30,254; Denmark, 28,301; Switzerland, 27,606; Italy, 20,559; Great Britain, 6,554 tons.

In the secondary iron and steel products, which are included under the tariff classification of machinery, the sales of locomobiles of all classes in 1907 amounted to 42,894,000 marks ($10,268,000). The sale of steam engines amounted to 7,087,000 marks ($1,758,000), the buyers being France, Italy, and other European countries. In mining machinery Germany is behind the United States and Great Britain.

Sales of textile machinery were heavy and also of metal machinery, the latter having amounted to 65,735,000 marks ($15,675,000). The exports of woodworking machinery were 9,771,000 marks $2,325,000).

COMPETITION WITH UNITED KINGDOM.

The origin and destination of the leading iron and steel imports and exports gives instructive indications of the tendencies of Germany's international commerce, and particularly of the successful competition with the United Kingdom. Comparisons are given for the calendar years 1906 and 1907, when trade was at its highest levels.

	1906.		1907.	
	Quantity.	Value.	Quantity.	Value.
Loop iron, raw rails, ingots.	*Tons.*		*Tons.*	
Imports	7,170	$257,516	8,238	$356,524
Sweden	4,491	178,500	5,975	262,990
Exports	366,359	7,133,812	227,536	5,587,768
Belgium	73,435	1,433,912	38,580	945,812
France	19,676	382,228	10,611	260,134
Great Britain	217,273	4,221,644	116,041	2,844,576
Italy	16,050	315,588	18,006	441,490
Holland	11,446	222,768	4,897	119,952
Austria-Hungary	9,386	183,974	16,876	412,944
Switzerland	9,125	182,004	12,227	299,642
Raw iron.				
Imports	409,083	6,669,950	443,624	7,746,702
Great Britain	358,532	5,523,742	390,156	6,500,018
Sweden	31,962	856,800	32,953	902,020
Exports	479,772	7,293,296	275,170	4,674,558
Belgium	378,274	6,085,184	185,378	3,088,516
France	26,105	387,702	36,931	615,230
Holland	15,607	241,570	11,498	205,156
Austria-Hungary	7,872	124,474	6,944	123,998
Switzerland	18,600	315,350	20,254	385,560
United States	28,871	426,668	7,953	142,086
Fish plates, ties, etc.				
Exports:	165,047	4,171,902	206,940	5,507,320
Great Britain	11,942	302,022	4,678	130,424
Holland	7,574	241,094	8,110	254,898
Switzerland	14,435	340,340	16,958	427,448
Turkey in Asia	9,022	210,630	17,608	451,010
German Southwest Africa	9,540	230,622	10,803	285,362
Argentina	65,088	1,565,374	93,245	2,388,092
Steel rails.				
Exports	369,269	9,139,676	417,693	12,049,000
Belgium	18,152	473,146	28,301	842,044
Denmark	6,942	173,564	6,559	188,668
Great Britain	41,031	928,438	20,589	911,660
Italy	8,018	221,340	9,443	293,692
Holland	25,454	638,488	33,254	910,312
Portugal	6,090	143,990	9,468	270,368
Sweden	13,633	322,752	9,566	273,224
Switzerland	23,007	537,602	27,306	844,900
Egypt	16,096	381,276	4,613	131,852
British South Africa	8,112	193,304	9,081	259,658
German South Africa	11,133	288,456	10,615	302,212
British Indies	11,230	271,082	15,750	449,820
Japan	20,892	515,270	36,710	1,048,390
Dutch East Indies	9,093	232,288	9,054	248,706
Argentine Republic	44,196	1,112,412	71,499	2,042,040
Brazil	34,461	850,136	13,753	392,224
Chile	7,583	184,688	73,536	386,402
Mexico	13,604	732,248	23,704	676,872
Australasia	5,935	144,228	5,257	150,178

GERMANY'S EXPORT CAPACITY.

The figures of the trade in 1907 may be taken as the high-water mark in the progress of twenty years. When this level will be reached again and exceeded is purely surmise. Nevertheless, in the universal depression which supervened in the iron and steel trade in the early winter of 1907, Germany made a remarkable showing in keeping up her share of international commerce. Her maintenance of the foreign market during this period is a striking illustration of her export policy. The first nine months of 1908 were months of complete prostration, yet during these months Germany actually exceeded her exports of the first three-quarters of 1907 both in primary and in

secondary iron and steel products. This appears from the following summary of the first nine months of the years given:

Nine months—	Primary products.		Machinery.	
	Imports.	Exports.	Imports.	Exports.
1907	$21,317,000	$139,374,000	$237,645,000	$119,001,000
1908	16,603,000	146,574,000	20,448,000	122,420,000

The unrevised official statistics are available for the first nine months of 1908, and a comparison of some of the leading articles of export may be made both as to quantities and values for the same period in 1907. The comparison follows:

Article.	9 months, 1907.	9 months, 1908.	Article.	9 months, 1907.	9 months, 1908.
Raw loops, blooms, slabs, billets, plates, etc	$3,954,000	$7,936,000	Fish plates, bedplates	$789,000	$641,000
Girders	9,296,000	6,411,000	Crank axles, wheels, etc.	3,454,000	3,702,000
Unshaped bar iron	4,599,000	9,303,000	Projectiles, guns, etc	9,750,000	10,553,000
Corrugated iron	431,000	581,000	Bridge and bridge material	392,000	627,000
Wire products	8,753,000	10,309,000	Parts of iron for construction	1,302,000	3,037,000
Tubes and pipes	7,001,000	6,507,000	Iron plows	1,605,000	1,743,000
Steel rails	8,996,000	7,578,000	Fine cutlery	4,530,000	4,023,000
Railway ties	3,608,000	1,897,000			

DESTINATION OF EXPORTS.

Analysis of some of these articles with reference to the destination shows that Great Britain was compelled to take large quantities of the surplus products from the German iron and steel mills. The exports of raw loops, blooms, etc., to Great Britain in the first nine months of 1907 were 86,560 tons; first nine months, 1908, 153,665 tons. Belgium took 26,242 as against 37,633 tons and Austria 7,895 as against 63,261 tons in the respective periods.

In the export of girders there was a falling off from 311,000 to 214,976 tons. Great Britain had some relief, since the drop in exports to United Kingdom was from 92,772 to 86,508 tons. Japan showed an almost total cessation, the decrease being of 5,277 to 1,369 tons.

Several countries were made to take largely of the surplus supply of unshaped bar iron. The increase of the nine months' period in the case of Great Britain was from 9,467 to 27,217 tons, while the exports to the British Indies were increased from 10,226 to 47,507 tons.

It appears from the detailed figures that Germany made a dexterous and determined effort to keep her markets in the Orient, losses in one class of products being compensated by increase in others. The sales to other continental countries of Europe have no special significance, but the value of the market maintained in South America, *and particularly* in the Argentine Republic, is apparent.

It is not the least remarkable fact that with the inevitable decrease in the exports of steel rails due to falling off in railway building all over the world Germany was able to keep up the total volume of her iron and steel exports so as completely to offset this loss.

A more complete comparison is had from a tabular exhibit of the shipments of articles to some of the leading countries. The following table shows German shipments for the first nine months of 1907 and 1908:

	1907.	1908.		1907.	1908.
	Tons.	*Tons.*	Steel rails—Continued.	*Tons.*	*Tons.*
Raw loop, billets, blooms, etc.	161,341	323,720	Great Britain	14,055	10,426
Great Britain	86,560	153,665	Holland	23,547	27,565
Belgium	26,242	37,633	Switzerland	23,026	26,607
Austria-Hungary	7,898	63,261	Turkey in Asia	2,290	7,526
Girders	311,710	214,976	China	2,558	8,872
Great Britain	92,752	46,588	Japan	24,730	31,658
Argentine Republic	14,413	12,811	Argentine Republic	64,526	22,473
Japan	5,277	1,369	Brazil	9,736	14,472
Bar iron, unshaped	147,949	299,305	Chile	9,407	2,326
Great Britain	9,466	27,217	Mexico	19,190	4,289
British Indies	10,225	47,507	Railway ties	144,387	75,919
Argentine Republic	10,072	24,609	Argentine Republic	76,472	19,186
Austria-Hungary	2,440	10,764	Turkey in Asia	12,120	10,980
Roumania	6,311	16,754	Crank axles, wheels, etc	55,813	59,829
Corrugated iron	5,035	6,777	Great Britain	622	1,870
Argentine Republic	1,691	1,853	British India	1,362	3,165
Raw wire	83,689	103,577	Canada	5,205	3,617
Belgium	27,944	43,772	Fish plates	21,968	17,564
Great Britain	20,357	25,122	Argentine Republic	5,145	1,381
Drawn wire	126,611	141,064	Brazil	321	683
Great Britain	22,003	14,500	Chile	847	69
Japan	5,570	11,914	Bridge and bridge material.	5,952	9,758
Argentine Republic	17,072	18,452	Argentine Republic	888	201
Brazil	2,759	3,525	Parts of iron construction	15,630	36,475
Tubes, pipes, etc	87,260	83,769	China	552	1,150
Great Britain	3,216	2,980	Japan	214	1,340
Japan	1,378	220	Argentine Republic	1,727	2,107
Argentine Republic	1,676	1,332	Brazil	911	2,254
China	346	681	Chile	2,186	9,074
Steel rails	311,878	262,704	Projectiles, guns, etc	22,264	24,099

TRADE WITH THE UNITED STATES.

The trade in iron and steel products between Germany and the United States has few striking features. The German statistics, particularly as to imports, are not conclusive, since some of the material imported through German ports is reexported to other countries of the Continent. Some German exports to the United States, which are shipped through Rotterdam and Antwerp, are also credited to Holland and to Belgium, but the quantity is not large.

When the United States began to supply itself with wire nails of its own manufacture, that was a distinct loss of trade to Germany, but the loss became much more acute when the United States invaded the Orient and captured a valuable market for wire products. This market it has since held, and Germany has sought compensation by trying to increase her exports of other iron and steel products to the United States. During the last year American competition has interfered seriously with Germany's shipments of steel sheets to England.

SALES TO THE UNITED STATES.

The United States hardly can be called a steady customer of Germany for pig iron, though small quantities are regularly taken. The exports of pig iron as shown by the German statistics for the calendar year 1907 were 7,952 tons, while loop iron was exported to the quantity of 1,112 tons. Girders, tubes, steel rails, railway ties, and fish plates are exported from time to time in exceptional circumstances, but the German mills hardly regard the United States as a reliable market for any of these products. Decorated cornices form an item of some importance. The mills at Aix la Chapelle, which in 1906 exported girders and similar material to the amount of $144,000, saw their sales drop in 1907 to $7,000.

The best American market for finished-steel products is that for cutlery, which Germany now disputes with England, the exports ranging well above $1,000,000 annually. In secondary products the United States affords Germany a market for textile machinery and in a lesser degree for wood working and similar machinery. The total exports of these products, however, do not average above $2,000,000 annually.

PURCHASES FROM THE UNITED STATES.

The United States on its part has been increasing most of its exports of finished products to Germany. In spite of the protective tariff and of the efforts of the German manufacturers to provide agricul-

tural implements, the importations from the United States continue above $1,000,000 annually, though some of them undoubtedly are for reshipment to other Continental countries. In metal-working machinery, notwithstanding all the efforts of the German manufacturers to provide machine tools of their own construction, and notwithstanding their own exports, the American makers hold their ground. This is partly due, it is claimed, to the inability of the German manufacturers to develop an inventive spirit, their chief reliance still being on copying American designs. Builders' hardware, saws, and hand tools also form a prominent list of importations.

The establishment of branches of American mills in Germany for the manufacture of machine tools and parts of machinery for the installation of factories, etc., does not seem entirely to have done away with the importation of these articles also from the United States. In Cologne, Düesseldorf, and other centers of the selling agencies exhibits of American mining machinery, drills, machine tools, etc., are made in competition with the German manufacturers.

TRADE BETWEEN THE TWO COUNTRIES.

The general run of the trade between the two countries is shown in the detailed figures for the different articles. The German tariff classification, which was introduced when the new commercial treaties were put in force in 1906, is followed. On account of this change it is not practicable to make a comparative showing for a period of years. That can be had from the figures of imports and exports as given by the United States statistics. In the following table, which gives the trade in primary iron and steel products between Germany and the United States for 1907, the German classifications and designations are followed exclusively, the translation being made from the German customs statistics. The quantities are in double hundredweights or units of 100 kilograms (220 pounds) and the values in terms of 1,000 marks ($238).

IMPORTS FROM UNITED STATES, 1907.

	Quantity.	Value.
	100 kilos.	*1,000 marks.*
Iron, alloy of iron, wares made thereof:		
Raw iron and alloy of iron not forgeable	6,532	46
Fine art casting and other fine casting, not forgeable:		
Stoves and parts of stoves	72	3
Other articles	141	19
Coating not forgeable (otherwise not described):		
Parts of machines, crude	1,504	32
Other iron goods	967	13
Parts of machines, wrought:		
Of locomotives, locomobiles, steam turbines, and other power machines	370	35
Of agricultural and dairy farm machines	3,508	340
Of electric engines, parts of other electro technical productions	10	1
Of machines above not specially mentioned	1,994	179
Kit for service pipes, cocks, valves, etc	324	36
Other goods not specially mentioned, shaped	5,636	304
Forgeable iron in bars:		
Shaped bar-iron, n.s.m.	651	9
Bound and tire-iron	704	11
Sheet metal, thick:		
Over 1 mm. to under 5 mm. thick	109	2
Under 1 mm. thick	411	10
Sheet metal, rough hewn, enameled, varnished, polished, browned, or otherwise artificially oxidized	134	11
Wire:		
Not polished, varnished, or overlaid with other metals, rolled	75	2
Drawn out, n.s.n	1,271	45
Winding tubes, rolled or drawn out; pieces of molds for pipes, shaped	104	4
Other tubes, rolled or drawn out; crude with a thickness from 2 mm. upward	493	11
Forgeable casting, forged pieces, and other articles made of forgeable iron:		
Iron for rough parts of engines, vessels, etc.—		
Roughly forged in piece, weight above 25 kg	147	6
Above up to 25 kg	3,200	176
Other iron mongery, unforged	5,705	200
Parts of machines, shaped:		
Of locomotives, locomobiles, steam, and power machines	86	18
Of agricultural and dairy farm machines	3,411	613
Of machines n. s. m	1,393	180
Projectiles, guns, stoves, radiators, saw-tooth scraping tools, transmitters, etc	4,216	679
Steam generators, specially for locomotives and locomobiles, made of forgeable iron, with more than 10 tubes of an equal size of 300 mm. or less width and up to 50 dz., pr. piece	44	6
Steam generators and drums, n. s. m	67	3
Gas and other reservoirs, vessels, tools, generators of forgeable iron, clinched, pressed, weld, etc	2,242	179
Joints of pipes and kits of forgeable iron for steam generators, drums, reservoirs, and similar requisites, etc.:		
Without other base metals	543	53
With other base metals in a piece weight of less than 10 kg	65	8
Iron crows, vise benches, hammers above 10 kg., per piece	52	3
Pulley blocks, cranes, and other transportable funicular machines	867	22
Spades, shovels, kitchen pans, hoes, fire tools	244	5
Plowshares, plow breast boards	151	5
Hay and similar pitch forks	1,734	130
Scythes, sickles, straw knives, fanned	30	5
Circular saw, handsaws, fret and saw blades	89	35
Other saw blades	472	90
Files up to 16 cm. length	271	95
Gimlets, awls, ratchet drills, reed knives	827	290
Tongs	98	20
Pruning—rose, hedge, tree, tin, sheep, etc., rough shears	19	6
Bore bits, chisels, turner's chisels, punching tools, graving tools, hollow chisels, plane irons	96	29
Machine knives	3,246	649
Twist drills, cutters	469	328
Measuring instruments	87	40
Axes, hatchets, hacks, needle drills, adjustable screw keys and tools, n. s. m	1,520	167
Hammers up to 10 kg. per piece	42	3
Chopping, thick kitchen, garden cutting, and others o. n. m. thick knives, thick paper knives, scissors, wood carvers	50	8
Plows for power working	510	46
Grubbers, harrows, hand and horse rakes, cultivators, potato forks, etc	6,362	385
Flatirons, hasps, heckles, traps, and other requisites for the household use	537	54

IMPORTS FROM UNITED STATES, 1907—Continued.

	Quantity.	Value.
	100 kilos.	*1,000 marks.*
Weaving shafts, weavers' trimmings, weavers' trimmings rings, weavers reed, and other similar articles for power looms, spinning and twine machines	13	10
Screws, clinches above 13 mm. inside screws, rivet plates for screws, brackets	110	3
Shafts (axis), n. s. m., fashioned	39	1
Carriage springs n. s. m.	77	4
Wire cables, brushes, baskets, horseshoes, hooks, o. n. m., case handles, etc., spiral springs of wire, little hooks, loops	665	26
Screws, clinches up to 13 mm. diameter	173	9
Rosette stift nails, n. s. m.	170	24
Cut nails	588	24
Stovepipes, boxes, butts, chests, baths, shutters, bells, horse combs, etc., of tin, parts thereof	188.35	.....
House and kitchen tools, kitchen articles made of iron plate, fashioned	362	36
Chains (except bicycle, land-measuring, door chains, and chains for towing):		
Unfashioned	139	5
Fashioned	132	14
Skates, roller skates	3	1
Ironwork (fittings, armors, etc.), of buildings and furniture, door handles, etc., of forgeable iron	1,781	178
Locks (not of rifles or revolvers, etc.), keys	148	26
Iron safes	47	5
Furniture, parts of furniture, not padded; gymnastic appliance	134	5
Fine knives, fine scissors, fashioned	26	17
Other fine cutting wares, side arms, etc., fine forks, corkscrews, etc	50	15
Pencil and pen holders, thimbles, fine bells, fine ironmongery, fashioned	71	15
Wig, glove, hat, and o.n.m. iron springs	105	16
Pens	6	6
Needles (sewing)	6	5
Sewing, knitting, stitching, stocking, frame needles	58	290
Pin, copying, hecking, hair, scraping, knitting, packing, and other needles; needle point fishing hooks	18	5
Broken old iron, etc	4,798	28
Rubbish of tinned sheet iron up to 5 m. thickness	5,022	33

EXPORTS TO UNITED STATES, 1907.

Iron and alloy of iron wares made thereof:		
Raw iron and alloy of iron not forgeable	76,525	597
Tubes and pieces of molds for pipes of not forgeable cast over 7 mm. thick, unfashioned	14,479	188
Iron mongery not specially mentioned, of not forgeable fine art casting and other fine cast	49	7
Unforgeable casting pieces of machines:		
Unfashioned	330	7
Other iron mongery, unfashioned	1,157	17
Iron mongery not p.m., fashioned	3,182	175
Unfashioned (raw) loops, (iron blooms), rails, blocks, slabs of iron, blocks, roughed-down plates, crucible steel in blocks, billets	60,090	619
Iron in bars:		
Iron columns, girders	14,360	154
Bar iron differently formed	11,252	146
Band and tire iron	2,808	42
Other nonshaped iron, iron in bars for refounding	7,523	98
Tin, thick:		
Without tinder, etc., of 5 mm. thickness and more	5,084	76
Over 1 mm. to under 5 mm	4,379	64
Up to 1 mm	420	9
Tin, rough hewn, enameled, varnished, etc	208	17
Galvanized	203	7
Overlaid with other base metals or alloy of base	233	8
Corrugated iron	311	11
Tin, pressed, weld, pierced, bored, etc	200	6
Wire, rolled or drawn out, including shaped and flattened:		
Not polished, varnished, etc., rolled	147	.....
Drawn out, with the exc of wire strings	4,376	95
Drawn out, galvanized	1,868	37
Polished, varnished, etc	617	13
Winding tubes, rolled or drawn out, pieces of molds for pipes unfashioned	78	2
Other tubes, rolled or drawn out, with a thickness from 2 mm. upward, unfashioned	8,696	203
From 2 mm. upward, fashioned	445	29
Under 2 mm., fashioned	11	1
Rails, switches, railway frogs of forgeable iron	63,089	757
Railway sleepers	33,580	353
Fish plates, railway bedplates	1,478	22
Crank axles, railway wheel irons, wheels, set of wheels	202,251	526
Iron for rough parts of machines, vessels, etc., roughly forged	3,220	113

EXPORTS TO UNITED STATES, 1907—Continued.

	Quantity.	Value.
	100 kilos.	*1,000 marks.*
Other ironmongery, unfashioned	2,842	85
Projectiles, guns, stoves, tubes, etc., welded, etc., neither rolled nor drawn out	6,809	1,253
Parts of iron constructions, made of forgeable iron, with the exception of bridges, etc	264	9
Locomotives and locomobile generators (3 pieces)	514	67
Steam generators made of unforgeable casting (1 piece)	113	5
Gas and other reservoirs, etc., made of forgeable iron, plinched, etc	4,070	326
Iron crows, vise benches, hammers above 10 kg. pr. piece	44	3
Pulley blocks, cranes, and other transportable furnicular machines	321	22
Spades, shovels, kitchen pans, coal scoops	425	14
Plow shares, plow breast boards	51	2
Scythes, sickles, straw knives, forged	38	7
Circular band fret saw blades	38	15
Other saw blades, hand saws	45	8
Files up to 16 m. length	11	3
Others	37	7
Rough (thick) carving tools of all sorts, with the exception of thick knives and scissors and roughly forged knife mongery	357	82
Tongs	1,897	342
Rough knives and scissors of all sorts	224	60
Bore bits, chisels, punching tools, etc	72	14
Machine knives	70	14
Measuring instruments (w. exe. of cutting compass)	39	15
Needle drills, adjustable screw keys, screw clamps, and other n. s. m. tools	308	34
Hammers, up to 10 kg. per piece	330	20
Watchmakers' tools	39	49
Iron plows	43	2
Balances (pairs of scales)	42	4
Flatirons, hasps, traps, and other requisites for the household industry	1,101	143
Card-clothing machines	79	47
Spindles	49	14
Weaving shafts, weavers' trimmings, etc., for spinning machines, etc	107	86
Fish plates, screws, keys, sleeper screws, etc	1,451	58
Screw clinches above 13 mm. inside screw, rivet plates for screws, brackets	209	6
Horseshoes, etc	111	4
Railway car fittings, railway buffers	48	2
Railway switches (parts thereof) and signal parts	1,993	82
Railway car springs, buffer springs	102	3
Other carriage springs	255	11
Wire cable, wire trimmings	90	5
Barbed wire, cramps, loops of iron wire	313	16
Wire brushes, brooms, hooks, n. s. m., case handles, etc., spiral springs of wire, little hooks, loops	998	45
Screws, clinches up to 13 mm. thickness of stift	606	32
Rosette stifts nails n. a. m., incl. horseshoe nails	175	11
Wire stifts	544	10
Cut nails	20	2
Stovepipes, boxes, butts, chests, baths, of iron-plate tin, parts thereof	933	104
House and kitchen tools, kitchen articles of iron plate:		
Unfashioned	517	28
Fashioned	26,197	2,620
Chains (with the exception of bicycle, land measuring, and door chains):		
Unfashioned	441	17
Fashioned	2,700	149
Snaffles, bridle bits, spurs, and other driving and riding harnesses	7	2
Skates, roller skates	41	9
ronwork (fittings, armors, etc.) of buildings, furniture, door handles, etc., of forged iron	335	30
Locks (not of rifles or revolvers), keys	480	60
Iron safes	34	3
Furniture, parts of non-padded furniture, gymnastic appliance	140	6
Roughly forged knives	9	2
Fine knives (forged)	10,115	6,964
Pencil and pen holders, thimbles, fine balls, and other fine ironmongery	2,319	427
Artistic smithwork	13	3
Umbrella frames, parts thereof	304	37
Wig, glove, and similar iron springs, n. s. m	23	3
Busks (whale bones)	147	15
Writing pens	8	5
Sewing pins	586	352
Sewing, knitting, stitching, stocking, frame needles	213	1,278
Pins, heckling, knitting, hair, packing, a. o. needles, fishing hooks	5,048	909
Broken iron, old iron, iron-file dust	448	3
Iron and alloy of iron not previously described	38	22

AMERICAN AND GERMAN COMPETITION.

The decreased demand after the high level of prosperity in the first nine months of 1907 was felt very severely in the exportations of iron and steel products to the United States. Germany was not able, as with Great Britain and some other countries, to compensate herself for the loss of home trade by increasing her exports to the United States. Instead there was a universal falling off. It will be necessary, however, to await the statistics for the full calendar year in order to form an opinion on the relative position of the two countries in their reciprocal commerce in the depressed year 1908. For purposes of comparison of the tendencies of the trade in normally prosperous periods 1907 may serve as index.

In so far as relates to competition between Germany and the United States in the markets of the world, especially in Great Britain, the Orient, and South America, fluctuating and unsettled prices toward the close of the year for leading products render predictions of little value, yet it may be assumed with certainty that export prices will continue to be made with the view of participating largely in international commerce. The best measure of these prices is afforded in reality by Belgian competition, since Antwerp prices govern. In November a leading iron and steel works at Liege quoted the following prices per ton f. o. b. Antwerp: Raw iron, $12.54; bars, $22.39; rails, $25.54; wire rods, $25.79.

PIG-IRON SYNDICATES.

By A. M. Thackara,
American Consul-General at Berlin (report dated December 12, 1908.)

The dissolution of the German pig-iron syndicates has resulted in the demoralization of the German pig-iron market. Sellers and buyers are uncertain how to act under the new conditions, and already there has been a considerable reduction of the prices. The disorganization of the iron market is clearly indicated by the fact that during November all quotations were withdrawn on the Düsseldorf Exchange. There has, however, been a disposition to take advantage of the unusually low prices to lay in stocks of pig iron for future consumption, which has resulted in making the prices firmer. On December 5 last the prices of pig iron for this year's delivery were fixed by the Mining Exchange at October rates, but for 1909 deliveries the prices, with the exception of Luxemburg puddle iron, were much lower. They are as follows, per metric ton (2,204.6 pounds): Spiegel iron, 1909, 66 to 68 marks ($15.71 to $16.18); 1908, 78 marks ($18.56). Puddle iron, 1909, 58 to 60 marks ($13.80 to $14.28); 1908, 68 marks ($16.18). Steel iron, 1909, 60 to 62 marks ($14.28 to $14.76); 1908, 70 marks ($16.66). Thomas iron, 1909, 54 to 56 marks ($12.85 to $13.33); 1908, 64.8 marks ($15.42). Luxemburg puddle iron, 1909, 52 to 55 marks ($12.38 to $13.09); 1908, 50.4 marks ($12). Luxemburg foundry iron III, 1909, at Luxemburg, 48 marks ($11.42). German foundry iron I, 1909, 58 to 60 marks ($13.80 to ($14.28); 1908, 72 marks ($17.14). German foundry iron III, 1909, 57 to 58 marks ($13.57 to $13.80); 1908, 69 marks ($16.42). Hematite iron, 1909, 59 to 61 marks ($14.04 to $14.52); 1908, 75 marks ($17.85).

Efforts have been and are now being made, looking to the formation of a general syndicate for the whole pig-iron industry, but there does not seem to be much chance of effecting any agreement which would be satisfactory to all the interests concerned.

SYNDICATE RENEWALS.

It now appears to be reasonably certain that the negotiations which have taken place among the Luxemburg-Lorraine blast furnaces during the past few days, will result in a renewal of the Luxemburg-Lorraine Syndicate for a period of three years. After the Rhenish-Westphalian Syndicate, and somewhat later the Siegerland Syndicate, had decided upon dissolution, the continuation of the Luxemburg-Lorraine Comptoir, which was to expire at the end of the present year, became questionable. The Gelsenkirchen Mining Com-

pany, which by its fusion with the Aachen Hütten Verein, with blast furnaces in Esch, had obtained a foothold in the territory of the Luxemburg-Lorraine Syndicate, and the Deutsch-Luxemburg Bergwerke und Hütten A. G., with its Differding furnaces, had hitherto shown a decided opposition to a continuation of the syndicate, but recently these large concerns have openly announced their willingness to enter the syndicate, and thereby have rendered reasonably possible, as stated above, the continuance of one out of the three more important German pig-iron syndicates.

As regards the other two, negotiations are still being carried on, looking to the renewal of the Siegerland Syndicate. At first three groups were formed, of which one wishes to have a general selling association for the various kinds of pig iron, a second desires only a selling association for spiegel iron, and the third a selling association for spiegel, steel, and puddle iron. Inasmuch as to the latter group belongs a very large percentage of the Siegerland pig-iron producers, the formation of a new Siegerland pig-iron syndicate is not entirely impossible. The case is quite different, however, with the important Düsseldorf Syndicate. The difficulties to be overcome among the Rhenish-Westphalian producers are so great that it can not be said that the prospects of forming a new syndicate are bright.

OPERATION OF COMBINE.

Under the old régime there were five syndicates, namely, the Rhenish-Westphalian, the Siegerland, the pig-iron syndicate of Düsseldorf, the Comptoir of Lorraine and Luxemburg, and the Upper Silesian. These syndicates, working under agreements with each other, virtually controlled the production, sale, and prices of the entire German pig-iron output. While the provisions of the members' contracts are confidential, the methods in general by which the Rhenish-Westphalian Syndicate was operated were as follows:

The syndicate was composed of 19 members, each of whom signed a contract binding each to sell his entire production to the central committee, which had its principal office in Düsseldorf, and a branch office in eastern Germany. All orders received were given direct to the central committee and apportioned to the different works, according to their quotas. The quotas were fixed by a committee of three members, and were based upon the capacity and annual production of each individual concern, the works being allowed to choose the best output in any one year during a period of three consecutive years. Every week each member was furnished with a statement of offers and orders received, without, however, any prices being stated. The invoices were made out by the con
livered the iron, on forms bearing the syndicate
tioning in the invoice the name of the manufa

were sent to the office of the central committee, and having been entered were forwarded to the purchasers.

MAKING OF PRICES.

Prices charged to customers of the syndicate were computed as follows:

The whole of the territory controlled by the syndicate was divided into three districts, southern Germany, western Germany, and eastern Germany, and in each of these one particular town was selected as suitable for fixing a price basis. For example, consider Munich as the place for southern Germany, Cologne for western Germany, and Myslowitz for eastern Germany.

If the price at Munich is, say, 12 marks ($2.86) for 100 kilos (220.46 pounds), then the price at Cologne is 12 marks plus one-half mark ($0.119) per 100 kilos, and the price at Myslowitz 12 marks plus 1.5 marks ($0.357) per 100 kilos.

To calculate the "making-up price," i. e., the cheapest quotation, a freight table was consulted which shows the rates from each of the members' works to every station in Germany. For instance, in "the making-up price" for Posen the following are the freight rates per 100 kilos: From Munich $0.766, from Cologne $0.628, and from Myslowitz $0.29. Iron supplied at Posen would cost therefore 12 marks plus the freight, or respectively $3.62, $3.61, and $3.51 from the three places in question.

This price must in any case be paid to the concern executing the order, which if possible should be placed with the Myslowitz works. Should this concern or another one in the neighborhood not be able to deliver the goods, a third one is given the order, and if this, for example, should be one either in Cologne or Munich, it will be seen that in this particular instance the business would entail a loss.

ALTERNATIVE ORDERING—EXCESS PRICE.

There is, however, always a chance for an equalization, as it often happens that iron can be delivered cheaper than the price basis. It must be understood that in order not to pay too great freight charges, the order will preferably be placed with works nearest to the consumer. It is only natural that firms situated in eastern Germany will on no account undertake deliveries to consumers living in western or southern Germany, as this would result in a serious loss. In reality such a case has never happened. On the other hand, it is just possible that southern or western concerns, which, owing to cheaper coal, etc., are in a position to produce at less cost than works situated in eastern Germany, are called upon to supply customers in this latter district, especially when they are short of orders.

To the basis price a fixed charge assessed by the syndicate directors, and called the excess price, was added. At the end of the year the profit derived from charging the excess price less managing expenses of the syndicate was divided among the members according to the deliveries made by them during the year. Should the syndicate be obliged to accept orders below the basis price, the works executing same must be indemnified with the difference between this and the price actually charged. The syndicate must try to adjust before the end of the year any differences resulting from deliveries above or below the quota allowed to each concern, but as this was not always possible, those works having exceeded their quota must pay a certain amount to the syndicate for each ton delivered in excess, while the syndicate had to indemnify those works which had not come up to their quota at the same rate per ton.

EQUALIZING LOSSES.

In order to control the works with regard to the deliveries effected on account of their quota, each received about every fifteenth day of the month a statement showing how it stood. Should the basis price prove too high in consequence of raw materials becoming cheaper or from other causes, a reduction to be fixed by the management of the syndicate in conjunction with representatives of the works forming the so-called "beirat" or advisory committee must take place. The advisory committee consisted of ten members, elected by the syndicated works, each quota of 10 per cent having one vote for one member. As the quota allowed to very large concerns sometimes exceeds 10 per cent of the whole amount, it may be that one individual concern was represented by two members.

The syndicate assumed the responsibility of a limited company, acting purely in the capacity of intermediary, and was not allowed to make either profit or loss. The syndicate stood surety for the goods supplied, so that losses incurred through failures were borne by the community of members. Very small amounts of goods, if absolutely necessary, could be offered by individual concerns direct to their customers at prices largely exceeding those charged by the syndicate. Such deliveries were charged on account of the quota of the concern supplying the goods. Twice every year each concern was visited by one of the syndicate's officers, who had to check all books and papers. The members forming the syndicate held syndicate shares for an amount of capital equal to their quota.

TRADE MEETINGS.

The members of the syndicate met six times a year for consultation on the points to be discussed, having been previously considered by the advisory committee. When the trade became dull and orders slack, the quotas of each concern were proportionately reduced to

prevent the accumulation of large stocks. Accurate statistics were kept of the quality and quantity of metal produced by each concern and the data sent to the central committee. The organization was an iron-clad contract in which each contracting party agreed to submit without conditions to all rules and measures adopted by the syndicate, or in default to be fined for disobedience. For this purpose blank acceptances were signed by each member and placed in the hands of the syndicate's treasurer. Should a member be fined, the treasurer filled in the amount of such penalty on the signed check and put it in circulation.

PIG PRODUCTION.

According to figures recently published by the German Iron and Steel Manufacturers' Association, the pig-iron production of Germany and Luxemburg in November, 1908, was 930,738 tons, against 941,582 tons in October, 1908, and 1,112,225 tons in November, 1907. The various classes of iron produced during the said month were as follows: Foundry iron in 1908, 199,380 tons; 1907, 189,942 tons; Bessemer iron, 1908, 20,856 tons; 1907, 36,747 tons; Thomas iron, 1908, 593,625 tons; 1907, 716,333 tons. Steel and spiegel iron, 1908, 72,215 tons; 1907, 98,741 tons, and puddle iron, 1908, 44,662 tons; 1907, 70,462 tons.

The production of pig iron since the commencement of the year 1906 by months was as follows:

Months.	1906.	1907.	1908.	Months.	1906.	1907.	1908.
	Tons.	*Tons.*	*Tons.*		*Tons.*	*Tons.*	*Tons.*
January	1,018,461	1,062,152	1,061,329	July	1,054,147	1,123,966	1,010,770
February	938,434	978,191	994,186	August	1,064,957	1,117,545	935,445
March	1,058,527	1,099,257	1,046,998	September	1,036,753	1,091,020	928,729
April	1,019,149	1,077,703	979,866	October	1,073,874	1,138,676	941,582
May	1,060,740	1,094,314	1,010,917	November	1,061,572	1,112,225	930,738
June	1,019,015	1,044,336	956,425	December	1,064,638	1,106,375	.....

The production during the 11 months of the present year amounted to 10,796,985 tons against 11,939,385 tons during the same period of 1907. The Upper Silesian furnaces produced in November 72,381 tons against 77,996 tons in October, 1908, and 76,279 tons in November, 1907. The production for the eleven months of 1908 was 851,990 tons against 860,270 tons during the same period of 1907.

A GERMAN RÉSUMÉ.

As of interest at the present time, I give a translation of an article by Dr. Felix Pinner, on the "Collapse of the German Pig Iron Syndicate," which recently appeared in "Die Bank," one of the local journals devoted to economic, industrial, and financial topics. Doctor Pinner gives a general résumé of the conditions of the German pig-iron industries, and states his reasons why, in his opinion, a general pig-iron syndication in Germany is not possible.

THE COLLAPSE OF THE GERMAN PIG-IRON SYNDICATE.

In the development of the German mineral industry, pig iron takes a middle place between the raw materials, coal and ore, on the one hand, and the half-finished products (steel), malleable iron, and cast iron on the other hand. By far the largest quantity of pig iron is manufactured into steel. Compared with the present total German pig-iron production of more than 12,000,000 tons, there is a steel production of about 11,500,000 tons, a malleable iron production of about 700,000 tons, and a production of cast iron of about 2,500,000 tons, the deficit of pig iron being made up of scrap iron which is used to a great extent in the manufacture of Siemens-Martin steel. The German Martin furnaces consume for their production of almost 4,000,000 tons ingots, only about 500,000 tons of pig iron, and about 3,500,000 tons of scrap iron.

According to the above genesis of the German iron industry, it must be conceded that a pig-iron syndicate is of fundamental importance to the German iron market; theoretically at least it is one of the principal foundations, if not the principal foundation of the schedule of prices for the home iron market. The Pig-Iron Syndicate is bound to exercise a powerful reaction, being the channel through which almost all kinds of iron products put upon the market, or entering into consumption, must pass. It must also have a great influence upon the fixing of prices of the principal auxiliary materials of the iron market, particularly fuel (coal).

STILL STRONGER INTERESTS.

Such a power of the Pig-Iron Syndicate was perhaps imagined by those who had not a very thorough knowledge of German industrial conditions, and who in the last few months had heard or read of a general syndicate, but the aims of the manufacturers who conceived these plans and endeavored to convert them into reality were probably not so highly directed. They also knew that a study of the structure of the German iron industry would indicate that a general German pig-iron syndicate never could have become the dominating German general syndicate.

Although pig iron must be rightly regarded as the basis of the German iron industry, yet the actual basis is the ore-mining industry, and that industry is not entirely German, inasmuch as of the German ore consumption amounting to about 35,000,000 tons, only about 26,750,000 tons are obtained at home, while 8,125,000 tons, that is to say about 25 per cent, have to be imported, the import of pig iron into Germany amounting on an average to, at the most, 5 per cent.

Nevertheless, as has already been stated, the pig-iron syndicate hitherto existing in Germany, which will be dissolved at the end of this year, have not by far possessed the importance for the German mineral industry, which must be conceded to the Rhenish-Westphalian Coal Syndicate or the Steel Syndicate. It may as well be stated in advance, that even if a general pig-iron syndicate, which would regulate the production and selling conditions, could be formed, it would never attain the considerable importance on the market as that possessed by the other two syndicates. A few figures will suffice to prove this.

SYNDICATE COMPARISONS.

The Rhenish-Westphalian Coal Syndicate has an annual production of 80,000,000 tons. Of this, about 50,000,000 tons are put upon the market, whereas a little more than 30,000,000 tons are consumed by the companies in producing coke and for their own use.

The coal syndicate dominates with its syndication therefore by far the greatest part of the Rhenish-Westphalian coal production. It is therefore of little importance that about 2 per cent of the total production of the Ruhr basin is

produced by works outside of the syndicate and sold independently. The quantities of steel consumed by the members of the Steel Syndicate and by the Siemens-Martin works, and which are not subject to the control and price regulation of the syndicate, are more considerable. Of the approximate 11,500,000 tons of German steel production, a little more than one-half is sold by the Steel Syndicate as half-finished products, and shaped iron or railway construction material; the rest is worked up into rolling-mill products and other finished manufactures, and therefore does not come upon the market and is not subject to the price regulation, but counts upon the contingent of the Steel Syndicate.

The Steel Syndicate exercises a dominant influence over the steel production of Germany, inasmuch as it controls the entire German output, both as to the kind of steel produced and the districts in which the products are manufactured. The conditions in the pig-iron industry are quite different. Of the total home production, which consists of 12,000,000 tons, about 9,000,000 tons are consumed by the producing works themselves. Besides the simple blast furnaces, there are those which include smelting works, puddling and rolling mills, or steel works; there are indeed those which embrace the entire process of the manufacture of iron and steel products.

STRENGTH OF STEEL SYNDICATE.

In the more important works the endeavor has always been to make themselves independent of the market as to raw and half-finished products and to supply the demand for these products from their own plants. Hence it happens that almost the entire German ore mining is in the hands of ore-consuming works, and the independent ore production only plays a rôle of minimum importance, and also that of the 12,000,000 tons German pig-iron production, 9,000,000 tons are consumed by the producers, whereas only 3,000,000 tons are put upon the market for such pig-iron consumers who do not produce their own pig iron. Naturally the syndication of these 3,000,000 tons of marketable pig iron by the Pig-Iron Syndicate would not affect the mineral industry in the way that the syndication of the 6,000,000 tons of marketable steel by the Steel Syndicate or the 50,000,000 tons of marketable coal by the Coal Syndicate does. If, notwithstanding approximately equal production figures, the Steel Syndicate and not the Pig-Iron Syndicate has become the backbone of our German iron industry, it is owing in the first place to the more complete control of the market exercised by the former syndicate.

There are also other reasons. The product which is more valuable, being manufactured and nearer ready for final consumption, will always exercise a more powerful influence in the industries than the raw product, especially when the former has become independent of the latter, whereas, on the other hand, all pig iron with the exception of that used by the Siemens-Martin works, the puddling works, and the casting foundries, must go through the Steel Syndicate. Furthermore the Steel Syndicate and not the Pig-Iron Syndicate is the real and typical representative of the interests of the large, mixed works who dominate the iron market to-day by virtue of their strong financial backing and their modern economical processes of production. Finally the steel industry and not the pig-iron industry has succeeded in covering the entire German territory, uniting within itself all the works and all the places of production in one syndicate.

CAUSE OF WEAK SYNDICATION.

If, in the foregoing, the limits have been indicated beyond which a syndication of pig iron should not have gone it will be attempted to be shown in the following why the pig-iron industry has never been able to effect a thorough

syndication. In the first place a brief description of the exceedingly complicated syndicate relations of the German pig-iron industry may be given. There are at present in this industry no less than five syndicates. The oldest is the "Rhenish-Westphalian Pig-Iron Syndicate" in Düsseldorf, which was founded in the year 1897; shortly thereafter the "Union for the Sale of Siegerland Pig-Iron" came into existence. These two syndicates entered into a contract, by the terms of which the sale of certain kinds of pig iron should be effected on common account by the "Pig-Iron Syndicate of Düsseldorf," a syndicate especially established for this purpose. The total contingent of the two syndicates in the Düsseldorf syndicate amounts at present to 1,404,900 tons, of which 72.32 per cent fall to Rhenish-Westphalia and 27.68 per cent to Siegerland. The trade in the kinds of iron not syndicated in the Düsseldorf Pig-Iron Syndicate is carried on by the individual syndicates independently. The foreign sales of both syndicates are also made independently; those of the Siegerland syndicate are attended to by the syndicate, and in the Rhenish-Westphalian syndicate they are left to the individual works.

Apart from these three cartels, there exist also the "Lothringische-Luxemburgische Pig-Iron Syndicate" in Luxemburg and the "Oberschlesische Pig-Iron Syndicate" in Beuthen. The latter is not of very great importance to the entire market inasmuch as the pig-iron production of Upper Silesia only amounts altogether to approximately 7.2 per cent of the entire German production and extends only a little beyond the boundaries of Silesia and the neighboring districts. The production of the "Lothringisch-Luxemburg Syndicate" is considerably larger, extending over the richest German ore deposits, the so-called Minette. In Lorraine, Luxemburg, and the Saar district, the working domain of this syndicate, in the year 1906, 38.3 per cent of the German pig iron was produced, and although a number of the works belonging to the syndicate are located outside of the German Empire, namely, in the State of Luxemburg, this fact can be left out of consideration in the questions discussed by us, for Luxemburg, after all, belongs to the German Customs Union.

THE COMPLICATED CARTEL.

Between the Pig Iron Syndicate of Düsseldorf and the Luxemburg Syndicate there existed only a kartell relationship, which led to the establishment of a common sales agency for the disposition of Thomas pig iron, Lorraine-Luxemburg quality, among the right Rhine and Westphalian works. In addition there were agreements regarding selling zones, allotment of orders, etc., which extended to the Rhenish-Westphalian Syndicate and the Siegerland Pig-Iron Association. The complicated provisions of this kartell, however, led later to differences, lawsuits, etc., and finally in the year 1906 to a refusal to continue the agreement on the part of the Rhenish Syndicate. Besides the associations mentioned, which, by the way, were never quite without outsiders, the so-called Coast Works (Küstenwerke) still come into consideration in the pig-iron market. In the first place, there are the Kraft Pig Iron Works at Kratzwiek, near Stettin, which belong to none of the mentioned syndicates, further, the Lübeck Blast Furnace Works, belonging to the Düsseldorf Syndicate, and finally, the Blast Furnace Works in Emden and Bremen still under construction.

Complicated as these relations may appear, especially when compared with the simple situation in the Steel Syndicate, there was, however, a time when the Düsseldorf Syndicate at least seemed to belong to the strongest German metal kartells. That was at the high tide of prosperity—about the turn of the century, at the time of the so-called pig-iron famine. When in the fall of 1901 the high tide of prosperity suddenly receded, the Pig-Iron Syndicate had made long-term contracts with its customers, which it compelled them to ful-

fill without any reduction and without any concession in the prices. This made the syndicate one of the best-hated kartells in Germany. Soon after this period the complicated mechanism of kartell agreements, which could only be kept in function by the boom movement, had suffered various interruptions. Moreover, the management of the Rhenish Syndicate was carried on without particular skill, its organization being indeed in some respects highly defective.

NUMEROUS DIFFICULTIES.

The syndicate had to defend its position in a whole labyrinth of lawsuits from all sides.

A part of its customers had united themselves into a Pig-Iron Selling Association, with its animus obviously directed against the syndicate. This association and other customers proceeded against the syndicate in tedious lawsuits. A lawsuit for 1,000,000 marks ($238,000) against the Luxemburg Syndicate, in whose domain the Düsseldorf Syndicate had encroached without permission, was lost by the latter. In general, the assessments of the Düsseldorf Syndicate, in consequence of the many expensive lawsuits, were so high that they were four times in excess of selling commissions which outside works had to pay to the dealers. The dealers' organization, which the syndicate had at first held sharply in hand, became more independent, as new and large-dealing firms were established which contested the privileges of the old syndicated firms, and besides foreign pig iron or that manufactured by firms outside the syndicate began to penetrate the market of the syndicate.

These attacks had all the more chance of success, as English pig iron when handled through the agency of strong and independent dealers could successfully compete with the native product, at least in the outer German districts, especially when the prices of foreign iron were low, while those of the native iron were kept artificially high. Besides England can not fully supply its home demand for half-finished products, and therefore has to depend on Germany for its deficit, but that country has generally an overproduction of pig iron, which under favorable circumstances, notwithstanding the custom duties, it can send into Germany. Then came the fights of some of the dealers, friends of the Rhenish Syndicate, against the Luxemburg Syndicate, which tended to keep the prices of the Dusseldorf Syndicate under pressure. An energetic campaign against the outside firms under these circumstances was not to be thought of.

POWER OF ONE FIRM.

It was the categorical refusal of the Kraft Works to participate in a general German pig-iron syndicate which wrecked the reorganization of the pig-iron syndication. The dramatic proceedings of the past few weeks, seemingly arranged on purpose, appear to confirm this assertion made in Rhenish-Westphalian quarters. Consequently it will be necessary to go more into detail into the relationship of the Düsseldorf Pig-Iron Syndicate with the Coast Works, and in particular to the Kraft Works. The Coast Works operate under quite different conditions to those of the pig-iron works in the industrial districts. They obtain their raw material mainly from abroad, their ore from Sweden, their coal from England.

They have also their particular markets, especially in the coast country located in their vicinity, which it is true in consequence of the small iron industries of those districts can hardly absorb the entire production of the Coast Works. In consequence, they are forced to carry a part of their production into the interior of the country, and here in the nature of things, they come into contact with the pig-iron associations. Thus, for example, Berlin is a district

which is contested by the Pig-Iron Syndicate and the Kraft Works. Hitherto things were partly remedied by a so-called allotment of zones, the same being determined by contract.

ZONE AGREEMENT PROPOSED.

This arrangement existed up to October 1, 1907, between the Pig-Iron Syndicate and the Kraft and Lübeck Coast Works. The Lübeck Blast Furnace Works joined the Pig-Iron Syndicate in the summer of the year 1907, after a lawsuit between the city of Bremen and the outsider firm of Klöckner & Co., of Duisburg, for the stock majority of the works had been decided in favor of the municipality. The Kraft Works, dominated by Prince Henckel, of Donnersmarck, however, declined to join, and he even undertook, on the contrary, to advance into the original domain of the Düsseldorf Syndicate, by obtaining a majority of the stock of the Lower Rhine Hütte belonging to the syndicate, and altering the plant into a perfectly modern blast furnace.

By this checkmate movement, which not only secured for him an advance post directly in the enemy's camp, but also created an immediately threatened point of attack against him, Prince von Donnersmarck considered that he had attained a position from which he could keep himself informed at all times of the proceedings of the Düsseldorf Syndicate and also of the western iron market, for the benefit of the Stettin works. When the preliminary negotiations for the formation of a German Pig-Iron Syndicate began, the Kraft Works declared from the very beginning that it would not discuss the question of entering the syndicate, but was prepared to make a zone agreement with a pig-iron syndicate when organized. In the west, they would not agree to this. As a matter of fact, therefore, the Pig-Iron Syndicate went to pieces even during the first introduction to the preliminary discussion on account of the attitude of the Kraft Works.

A LEVELING PROCESS.

The importance of the refusal of the Kraft Works as a matter of principle, in connection with the proposed syndication, should not be underestimated. This plant with its production of approximately 160,000 tons annually embraces only about 5 per cent of the syndicated German pig iron, but the Kraft Works no longer occupies the position of being the only coast works, as there are at present already four and the probability is that more will be constructed.

The question is only whether the problem "General German pig-iron syndicate" was rightly stated, as to whether it was really possible and expedient to constitute a general pig-iron syndicate.

The question is not so simple to answer as the actual or alleged supporters of the unit idea would assume. In not every union is there strength, and a mechanically leveling process is not necessarily desirable because a chaos hitherto existed. Thus, for example, the strength of the coal syndicate lies in the fact that it confines itself to Rhenish-Westphalia where uniform conditions prevail. A general German coal syndicate would be weaker, for it would be by far not so compact as the Rhenish-Westphalian. Just as in the coal trade, however, there are differences in the territorial conditions in the pig-iron industry. The Rhenish-Westphalian, the Lorraine-Luxemburg, the Silesian, and the Coast Works operate under quite different conditions as to production and sales. In my opinion, the formation of a tightly closed kartell is not at all possible in the pig-iron industry; the most that can be attained would be an agreement for the general definition of zones. If the great Pig-Iron Syndicate had not collapsed at the very outset of the negotiations as a

result of the comprehensible refusal, on principle, of the Kraft Works to even enter into negotiations, it would have gone to pieces later upon many other almost unsolvable problems.

CONFLICTING INTERESTS.

Thus, for instance, the agreement between the Rhenish-Westphalian and the Lorraine-Luxemburg Works was exceedingly difficult, and even more so was the question of the allotment of orders. The same was settled in the present syndicates quite uneconomically. Deliveries were not made by the individual works in the districts nearest to them in order to save freight charges, but, for example, under the management of the syndicate, the Westphalian-Aplerbeck Hütte made deliveries to Berlin, the Luxemburg Works to the Baltic Provinces, the Hessian Works Buderus to the central and lower Silesia, because all the works in the event of a later dissolution of the syndicate wanted to remain in direct contact with the consumers.

This "promenade" of the iron, as Director-General Grau of the Kraft Works so appropriately characterized it, would not have ceased in a new syndicate any more than the mistrust in the permanency and continued existence of the pig-iron syndication.

In general, I can not get rid of the suspicion that certain producers of pig iron only proposed the general German pig-iron syndicate as an indispensable condition, because they no longer wanted to have a pig-iron syndicate formed. Therefore such difficult and almost impossible provisions were insisted upon, that the whole scheme was the more sure to go to pieces. It is no accidental circumstance that a general pig-iron syndicate was particularly advocated by the big mixed iron works, who indeed are only dependent upon the pig-iron market for the relatively small part of their production, and who have in general no special interest in a strong pig-iron syndicate that would jeopardize the now almost absolute domination of the iron market by their steel syndicate. It is no accident that only Thyssen and Krupp were the ones to put in their veto when, at the eleventh hour, it was desired to come to an agreement in Rhenish-Westphalia without the Kraft Works.

SELF-CONSUMPTION THE FACTOR.

It is here that one strikes the greatest contrasts in the production of pig iron, which are a much more formidable obstacle to a strong syndication than all the territorial differences. It is the different conditions which exist in the great mixed works and in the simple blast furnaces. For the latter, the pig-iron market means everything; for the former it is only an outlet valve for superfluous raw material of which even to-day its production is capable of being lessened or extended at will, as the exigency requires. I have already shown that in the case of the pig-iron industry it is not the turn-over as with other large kartells, but the self-consumption which is the principal factor.

The mixed works consume 9,000,000 tons of raw iron in their own plants, for which they have not a single pfennig to pay the syndicate assessment. Their own consumption is in no way made contingent. Neither can they be forced to deliver to the syndicate their full allotment. Inasmuch as their own consumption naturally takes precedence, they have generally left the syndicate in the lurch in times of heavy demand on the pig-iron market, while in bad times they deliver to the syndicate their full quotas. They therefore possessed in the pig-iron syndicate a good working pig-iron surplus regulator. Quite differently situated to these works, which operate six to ten blast furnaces, were the simple blast furnaces, which had only at their

disposition three, two, or even one furnace. The latter had not the opportunity, as in the case of the mixed works, to keep their furnaces in blast at a profit and to advantageously dispose of their products. On the contrary, the favorable position of the mixed works was only secured at the expense of the simple furnaces. In addition to this, their plants, mostly rudiments of a former industrial phase of development, were frequently not of the technical excellence in point of production as in the case of the big, mixed works.

It must in the long run be impossible to keep two such different categories of producing plants together in one syndicate. In this case the same process of development will be repeated which has already taken place in another branch of the iron industry—namely, in that of finished products, particularly in regard to the simple rolling mills.

IMMEDIATE EFFECT.

In conclusion, just a word regarding the probable immediate consequences of the dissolution of the pig-iron associations. It must be assumed, as a matter of course, that the shaking of the prices of pig iron will, in the first place, strike and affect the simple blast-furnace works of Siegerland and Rhenish-Westphalia, which even without this can hardly continue to exist. Apart from the unfavorable conditions of production, they have not the powerful organizations for the disposal of their products upon the market as the mixed works have in the well-equipped selling agencies of the Steel Syndicate. It is claimed that the simple rolling mills would be benefited by a dissolution of the associations.

This is not necessarily to be conceded. Certain advantages will only be derived by the Siemens-Martin Works, the puddling and rolling mills, and the casting works which directly work up pig iron. In the case of the simple rolling mills, it is to be taken into consideration that they mainly use only steel which has first come through the Steel Syndicate. It is a question now whether or not the Steel Syndicate, which does not buy pig iron on the market but produces it itself, will, in consequence of the falling tendency of the market, be compelled to reduce its prices for half-finished products. This will depend upon the extent of pig-iron sales in the near future and the length of the period for which prices will be quoted.

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MACHINE TOOL TRADE

IN

GERMANY, FRANCE, SWITZERLAND, ITALY, AND UNITED KINGDOM

By

CAPTAIN GODFREY L. CARDEN

U. S. REVENUE-CUTTER SERVICE

Special Agent of the Department of Commerce and Labor

TRANSMITTED TO CONGRESS IN COMPLIANCE WITH THE ACT OF MAY 22, 1908, AUTHORIZING INVESTIGATIONS OF TRADE CONDITIONS ABROAD

MARCH 2, 1909.—Referred to the Committee on Interstate and Foreign Commerce and ordered to be printed

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1909

DEPARTMENT OF COMMERCE AND LABOR,
OFFICE OF THE SECRETARY,
Washington, March 2, 1909.

SIR: I have the honor to transmit herewith, in compliance with the acts making appropriations for the legislative, executive, and judicial expenses of the Government for the fiscal year ended June 30, 1908, and the fiscal year ending June 30, 1909, approved February 26, 1907, and May 22, 1908, respectively, the report of Capt. Godfrey L. Carden, of the United States Revenue-Cutter Service, detailed as a special agent of this department, on the Machine Tool Trade in Germany, France, Switzerland, Italy, and the United Kingdom.

Respectfully,

WM. R. WHEELER,
Acting Secretary.

The SPEAKER OF THE HOUSE OF REPRESENTATIVES.

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LETTER OF SUBMITTAL.

DEPARTMENT OF COMMERCE AND LABOR,
BUREAU OF MANUFACTURES,
Washington, January 18, 1909.

SIR: I have the honor to submit herewith for transmission to Congress and publication a special report on the machine-tool trade of Germany, France, Switzerland, Italy, and the United Kingdom. The author, Capt. Godfrey L. Carden, of the United States Revenue-Cutter Service, having been detailed for this work, spent nine months of the year 1908 in a personal inspection of leading machine-tool manufactories and establishments in which such tools are fabricated and used, and in making a study of industrial conditions as affecting the foreign trade in machine tools.

Respectfully,

JOHN M. CARSON,
Chief of Bureau.

To Hon. OSCAR S. STRAUS,
Secretary of Commerce and Labor.

MACHINE-TOOL TRADE IN GERMANY, FRANCE, SWITZERLAND, ITALY, AND UNITED KINGDOM.

INTRODUCTION.

This monograph comprises a compilation of reports made to the Bureau of Manufactures, Department of Commerce and Labor, and originally published in Daily Consular and Trade Reports, on the machine-tool situation in Western Europe during the first nine months of 1908. In that period the writer personally visited and reported on the installations and shop economies of the majority of the leading machinery and machine-tool plants of Germany, Switzerland, northern Italy, France, and the United Kindom. In the revision of the work for this monograph considerable fresh material and a number of photographs have been added. The writer's connection with this duty has been in the nature of a regular detail, for which work he was detached from the command of the United States revenue cutter *Onondaga* late in 1907.

As the time available for making these reports was limited it was not possible to visit more than representative establishments, but the endeavor was made to include in the report not only machine-tool building shops, but plants where machine tools are used in large numbers. It will be found that the reports include, in many instances, a list of the tools in service, and in some cases the prices paid for American and foreign built tools have been noted.

The writer avails himself of this opportunity to express his appreciation of the many courtesies extended him at the various plants visited and to note the readiness exhibited by so many firms at home and abroad to facilitate his investigations.

VAST TRADE EXPANSION.

In the manufacture of high grade machine tools the United States in the past decade and a half has easily led the world. During much of this period the enormous demands of the home market have taxed to the utmost the output capacity of many American manufacturing plants, and the foreign orders in these circumstances have necessarily suffered. Despite, however, the insistence of the domestic field the exports of machine tools from the United States has each year steadily

increased, but this increase has been due not so much to the efforts of American manufacturers in the foreign market as to the recognition abroad of the inherent merits of the best grade of American-built tools.

The possibilities of the foreign market, especially in recent years, has not it is safe to say been fully appreciated by the majority of American machine-tool builders. This is a natural outcome of the enormous demands at home. There has been little incentive to study over-sea conditions, and not only has the extent of the foreign business been underestimated generally, but the capabilities of foreign machine-tool builders have not been fully perceived.

To understand in a measure the magnitude of the foreign trade it is only necessary to study the export figures of other nations. In the year 1907, Germany for example, supplied to countries other than her own 52,553 machines for working in metal (Maschinen zur Bearbeitung von Metallen), representing a total weight of 96,920,560 pounds avoirdupois.[a] During the same period Germany exported reserve parts for the above tools to a total weight of 1,028,800 kilos (1 kilo = 2.2 pounds). The German exports in these machines reached 23 countries. The country purchasing the greatest quantity was Italy, followed in the order of shipment weights by Austria-Hungary, France, Switzerland, and Great Britain. These five countries received, independent of spare parts, 65,662,960 pounds of the total 1907 exports.

ACCESSIBLE MARKETS.

The bulk of the German foreign trade in 1907 was with western Europe, or countries distant about one week's travel only from New York, and offering as few, if not less, freighting difficulties as would be encountered in making shipments between Atlantic and Pacific coast ports. The statements here made with reference to machine tools must be understood as dealing only with metal-working machines. The German export figures give an independent statement with reference to forge tools and presses. No reference is here made to the exports for 1907 on the part of Great Britain, France, and Belgium, all three of which countries are doing good business in western Europe.

It is the enormous demand at home during the past two years that has deterred many American machine-tool manufacturers from giving that close attention to the foreign field which they might otherwise have done had conditions in the domestic trade been unfavorable. There are some American firms which do understand and appreciate the foreign situation; their number, however, is very limited.

[a] Imperial German export statistics.

COMPARISONS OF QUALITY.

Broadly speaking, the best grades of American machine tools excel both in design and workmanship, and in the accuracy of working results, the foreign-built tools. There are, however, a number of foreign machine-tool establishments which are approximating very closely to standard American work, and there are several plants where the designs and workmanship are of exceptionally high order. As a rule the medium size high-grade American machine tool brings more money abroad than does the foreign machine of the same size. These statements must be understood as covering the situation broadly. The exceptions are noted in the subsequent chapters of this monograph.

American machine tools are bought abroad, as a rule, only when possessing superior merit. The moment a foreign tool approximates in accuracy to an American machine tool the foreigner will buy the products of his own country; this is natural, and to be expected. The underlying consideration with the majority of first-class establishments when buying tools is the accuracy and merit of the machine, and it is for this reason that the question of price is not always the first essential.

We excel the foreigner, whenever we do excel him, by reason of superior technical knowledge. This is the crux of the whole situation, and it is folly for any American firm which proposes to hold its own in foreign competition to ignore technical education.

IMPORTANCE OF SPECIALIZING.

In the construction of machine tools, however, there is another point which is generally lost sight of, but which has a most important bearing both on the construction of machine tools and ability to maintain a lead over foreign efforts. This is the question of specializing. Under existing fiscal conditions our manufacturers have enjoyed the benefits of an enormous territory, in which foreign competition has been practically eliminated. The result has been that many of our manufacturers have been able to specialize; in other words, confine their efforts to the manufacture of a very limited number of designs of tools, and in some instances, as is well known, American manufacturers have centered their efforts on one tool design and have further restricted these efforts to but one size of a design.

Under such conditions it has been possible to give one's whole attention, thought, and energy to the development of a special tool, and it is not to be wondered at that the superlative, seemingly, has been attained, in some instances, in the building of special machines. As the antithesis, there is a prominent French machine-tool house

which undertakes to build 152 different designs of machine tools. The head of this establishment declared to the writer that the reason for handling so many machines was because of the limited territory available, adding that perhaps he too could specialize, as do the Americans, if his own country was practically restricted to French manufacturers; but in order to keep his shops going, he must, he declared, take almost every order which came along, and for this purpose it was necessary to keep a vast number of patterns on hand.

The ability to specialize, when accompanied by good executive control, generally means production at minimum cost and rapid building. There are but few foreign machine-tool works which are specializing in the American sense of the term, and in the case of one foreign firm which is confining its attention largely to one type of machine it is enabled to do so by reason of enjoying practically a subsidy.

CLOSER TOUCH WITH CUSTOMERS.

The writer has been forcibly impressed with the general desire on the part of officials of many of the European firms visited to meet the directors of representative American plants. Many American machine tools are being operated abroad without a full understanding of their capabilities, and it is asserted the only information which could be obtained by the purchaser was what he gleaned from a catalogue printed in English.

Very frequently these English printed catalogues contained shop terms, expressive and forceful to those understanding them, but impossible of translation to the foreigner. On the other hand, there are American machine tools in service in Europe which are not only understood but are in high favor, and largely because of personal visits from competent Americans.

GERMANY

MACHINE-TOOL TRADE IN GERMANY.

COMMERCIAL GROWTH.

INFLUENCE OF TRAINING ON TRADE DEVELOPMENT.

Germany is the country which offers exceptional interest to American manufacturers of machine tools. Not only are there a great many machine-tool building firms in the Empire, but the work turned out by several firms is of high order.

Germany probably leads the world to-day in economics and in the development of economical designs. At the great technical institute in Charlottenberg many hundred young men are graduated every year, and to a more or less extent the work at Charlottenberg is duplicated in the technical colleges in Leipzig, Munich, Hanover, Dresden, Dantzig, and elsewhere, and as fast as these German students are graduated, most of them with a very thorough engineering foundation, they are absorbed by the great iron and steel, machinery, shipbuilding, and other manufacturing plants, and it is these graduates who are giving Germany its strong position in the economic world of to-day.

If German machine-tool builders were able to specialize, as do many American firms, the writer predicts that it would not be long before the Germans would be abreast of some of the leading designers of the United States. In the construction of machine tools the Germans have rapidly acquired technical knowledge, and already they can boast in many instances of possessing fine shop organization. The German builders have everything practically but territory, and with territory the ability to specialize. Their country is too circumscribed to make it possible for a new firm to hope to live on domestic trade. Export business is therefore the life of the nation, and every thought and every energy is accordingly directed in the interest of export.

EXPORT STATISTICS.

The German exports of machines for working in metal during the year 1907, expressed in kilos (1 kilo = 2.2 pounds), were as follows:

	Kilos.		Kilos.
Italy	10,474,800	United States	458,400
Austria-Hungary	6,526,200	Roumania	391,000
France	6,486,100	Chile	337,900
Switzerland	3,484,700	Norway	320,000
Great Britain	2,875,000	China	259,200
Belgium	2,548,500	Brazil	214,000
Russia in Europe	2,219,000	Finland	194,400
Sweden	1,736,000	Bulgaria	139,300
Netherlands	1,175,000	Russia in Asia	124,900
Argentina	923,300	Australia	57,600
Denmark	794,400	Reserve parts exported to 9 of the above countries, total	1,028,800
Japan	548,700		
Spain	543,300		

The total weight of the exported complete machines for working in metal was 44,054,800 kilos. This figure is slightly in excess of the total of the preceding table and includes a number of scattering exports. The total weight in pounds avoirdupois is 96,920,560, or a weight in tons (2,240 pounds to the ton) of 43,268. On the basis that the 52,553 metal-working machines weighed a total of 96,920,560 pounds, there results an average of 1,844 pounds weight per tool.

In the year 1907 Germany exported forge tools, including steam and hydraulic forging presses, mechanical riveters and hammers, to a total of 1,956,700 kilos. These exports are entirely independent of the exportation of machines for working in metal (Maschinen zur Bearbeitung von Metallen).[a]

In the year 1907 Germany imported 9,106 machines for working in metal. These tools originated in Belgium, France, Great Britain, Switzerland, and the United States of America. The imports in kilos (1 kilo = 2.2 pounds) were as follows:

	Kilos.		Kilos.
United States	5,337,000	Great Britain	889,700
Belgium	113,500	Switzerland	178,100
France	299,800		

It will be seen from the foregoing tables that the imports into Germany of metal-working machines were greater from the United States than from any other country, and that Germany did a larger export business with Italy in 1907 than with any other foreign country. After Italy come Austria-Hungary and France.

[a] Imperial German export statistics.

ARMY INFLUENCE.

It is not too much to say that Americans in general have not been giving the Germans credit for learning and developing in machine-tool construction, and if it is proposed to keep ahead in shop efficiency, the United States must look to the training of workmen from boyhood up. Attention should be called to the excellent discipline in so many of the German plants, and for this fine discipline the real secret is probably to be found in the military system of the nation. It is the German army of to-day which is the great institution of learning for the mass of the people, and to thoroughly understand and appreciate German development, the German army must be reckoned with.

The German army teaches at the outset cleanliness, the proper care of the body, the use and development of physical strength. It teaches order and economy, self-respect, and honesty. It teaches discipline, how to obey, and how to command. It teaches deference for others, for one's superiors, one's equals, and one's subordinates. It teaches justice and it teaches tact. It teaches good behavior and it teaches good manners. It teaches respect for those in authority and for one's government. It teaches patriotism, and it teaches love of country. All these lessons are not learned in consequence of mere military service, but, on the contrary, are the result of instruction carefully imparted in recitation rooms in classes presided over by noncommissioned and commissioned officers, in which the progress and development of each recruit is carefully noted and verified. And what is the result? The soldier leaves the army with a developed capacity for work. Many a country boy never knew what he had in him until it was brought out by that great institution for learning—the German army. And these soldiers on leaving the colors return to their own communities, and unconsciously impart to those around them that great lesson and truth which they learned so well in the army.

Ask the German manufacturer who of all men make the best class of employees, and in the majority of cases the writer has heard the answer, "the man from the army."

THE LUDWIG LOEWE A. G. WORKS, AT BERLIN.

The Ludwig Loewe and Co. A. G. Works, in Berlin, may be regarded as representative of the best of the machine-tool building plants in all Germany. I visited the Loewe shops on February 8, 1908, and was informed that at that time there were approximately 2,000 men employed. In the department for the construction of machine tools for general purposes 462 machine tools were being operated by 475 men. These are skilled workmen. The greatest

number of machines attended by one operator is five. In this department, which is about one-fourth of the entire plant, one machine is the average number looked out for by one man. This average is obtained by separating foremen and those in charge of groups of the men who actually attend machines. In the assembling department the average number of machines attended by one operative approximates one and one-half. Here there are 304 operatives and 432 machines. In addition to the departments mentioned there are separate shops for the construction of machine tools for special purposes and for the manufacture of small tools. There is also a large and important foundry.

The Loewe works produce some of the best machine tools made in Germany. This establishment may be regarded as an example of those German shops which are strong competitors abroad of American machine-tool houses.

EARNINGS OF WORKMEN.

The rule at Loewe's calls for 54 hours of work per week per man, and the wages paid vary between 45 pfennigs per hour for unskilled labor to 1.25 marks and even more for skilled men (100 pfennigs=1 mark=23.8 cents). The expert men are generally paid by piecework. The average rate of wages paid by the hour, in pfennigs, is as follows:

Foremen in the assembling department	80	Skilled men for grinding machines	70
Vise men	60	Molders	72
Skilled lathe men	66	Core makers	60
Skilled planing men	70	Carpenters	53
Skilled milling-machine men	72	Patternmakers	65
Skilled men for boring mills	71	Forge men	72

The above, it must be understood, are guaranteed wages. As a matter of fact, Loewe's men are dissatisfied if they do not earn at the tools 85 pfennigs per hour. This they can readily do under the piecework policy. These men pay for house rent sums ranging from 240 to 270 marks per annum. The price paid depends upon the location in the city. For the above sums one room and a kitchen can be obtained. For two rooms and a kitchen house rents vary between 420 and 480 marks per annum. Berlin workmen, it should be understood, obtain, as a rule, better wages than those in other parts of the Empire, and the Berlin men enjoy the reputation of being unexcelled in their trades in Germany.

At least three special types of machine tools are turned out by the Loewe Works which are not made in American shops. Two of these are backing-off lathes, one with an automatic cross feed, and one for sliding, surfacing, and screw-cutting. The third tool is a circular

milling machine. Still another special appliance of this firm is an automatic indexing apparatus for universal milling machines.

The backing-off lathe with automatic cross feed is designed for backing off formed milling cutters with straight flutes. The cutters are first roughly formed and grooved, the number of teeth ranging from 3 to 25. This is a stiffly built lathe, and backs off without much vibration. The backing-off tool is moved forward by a cam and returned rapidly by springs. The movement is regulated by change gears and cams to correspond with the number of teeth on the cutter. Each tooth is so relieved that it retains its form, although nearly ground away by repeated sharpening. The bed is of box form, cast in one piece with the head stock. The spindle is hollow, has hardened and ground bearings, and runs in bronze boxes, which are scraped by hand to a fit, the front box being provided with means for compensating the weigher. The drive is by a 3-step cone through a worm gear, so that the machine will take a steady cut when working on broad surfaces. The cross slide is so arranged that the tool is automatically fed in at each revolution of the work spindle, the idea being to enable one man to look after more than one machine. The Loewe firm claims that the formed backed-off cutter plays an important part in reducing the cost of pieces of complicated shape, which can be finished on either surface or on circular milling machines.

The backing-off lathe has a greater capacity than the tool above described. It is furnished with a lead screw and feed rod, and will back off taps, spiral cutters, and worm-gear hobs, either right or left hand, as well as the ordinary form of backed-off cutter, having from 3 to 26 teeth. This tool has a taper attachment and a complete set of change gears for screw-cutting. The bed rests on legs of box form. The spindle is as above described. The belt feed has six changes and is reversed by a lever on the apron. The head stop has an attachment by which the pitch of thread obtained by the change gears can be increased twelvefold. On the tool post there is a screw adjustment for bringing the backing-off tool into exact position.

A CIRCULAR MILLING MACHINE.

The circular milling machine is designed to take the place of the lathe for work of such forms as can be produced by milling cutters, viz, gear-wheel blanks, either spur or bevel, grooved pulleys, hand wheels, flange pulleys with crown face, etc. The claim is made that one man can easily keep as many as 5 machines in operation, and that if the cutters are made with backed-off teeth not only is uniformity in the shape of the work secured, but the parts are machined more cheaply than on the lathe. The cutter spindle is of steel, has hardened and ground bearings, and runs in long bronze boxes, of which the

front one is adjustable for wear. The spindle is provided with a drawback bolt for cutter arbor, and is driven by backed gears having a ratio of 1 to 7. The outer end of the cutter arbor is supported by a movable tailstock, which must be taken away before milling internally. The cutter and the work are brought to a standstill simultaneously at each complete revolution of the latter by means of an automatic stop. The head is adjustable in both directions horizontally. It can be clamped firmly in place, and an adjustable stop is provided which insures the head being brought back to exactly the same point for each piece of work when milling parts of equal diameter. The work spindle is driven by a worm gear, which can be disconnected and the spindle directly revolved by hand wheel; changes

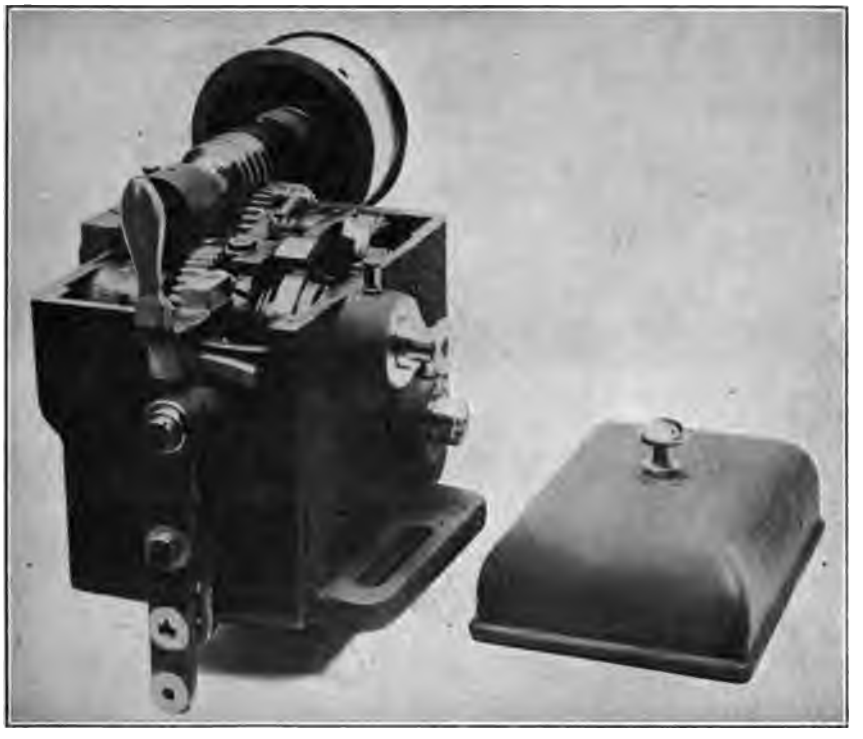

FIG. 1. Automatic index apparatus.

of feed are made by means of change gears. The outboard bearing supporting the outer end of the work arbor is carried on a knee, which can be swung aside when putting in or removing the work.

WHAT THE LOEWE WORKS PRODUCE.

In addition to the above special tools, the Loewe works are engaged in the manufacture of machine tools of types as follows:

(1) Plain milling machine with automatic feed of table parallel and vertical; (2) plain milling machine, back geared, with automatic

feed of table parallel and vertical; (3) automatic screw machine; (4) plain milling machine; (5) cutting-off machine; (6) vertical milling machine, with rapid turning spindle; (7) automatic spur-gear cutting machine; (8) semiuniversal automatic bevel-gear cutting machine; (9) automatic pin and stud machine; (10) turret lathes; (11) screw cutting lathe for copper stay bolts; and (12) drills.

FIG. 2.—Universal milling machine with automatic index attached.

The Loewe establishment represents one of the most advanced, if not the most advanced, plant of its kind in Germany. It is for this reason that the operations of these great works have uncommon interest for American machine-tool makers. In design the Loewe machines follow American practice more closely than European, although they are in nearly every case heavier than the usual American

type. The different features which they present, while said to be dictated by European demands and methods, would not always agree with what is deemed best in America.

From the list of tools given above it will be seen that the Loewe works are not specializing in the American sense, and yet the German firm contends that it is specializing far more than the average German plant; indeed, it is with the idea of devoting more attention to fewer tools that the Loewe firm has thrown out a number of machines which it has heretofore been in the habit of producing. The maxim is laid down at Loewe's that all tools should be made for stock, and not to order. This plan, it is asserted, assures quick delivery as well as low prices.

NORTON GRINDERS—DIVERSIFIED WORK OBTAINED.

In an inspection of the plant I observed that the Loewe people are laying great stress on grinding work. They have interested themselves in the Norton grinding machines and will undertake the production of that type of grinder in Germany.

German machine-tool makers have in a number of instances obtained work out of American machines which was not contemplated by the original designers. The Loewe works, for example, are making a specialty of an automatic indexing apparatus for universal milling machines.

Here we find an attachment to the standard millers, which, it is claimed, effects a saving of 50 per cent, if not more, in wages alone. Generally speaking, the dividing head in use at the present time on universal milling machines does not meet the modern demand for automatic action, as the actual division has to be done by hand. This often gives rise to mistakes which inevitably mean spoiled work. The workman must also stand idly by the machine in order to reverse the table and effect the next division. With the automatic indexing apparatus the universal milling machine is converted into an automatic gear cutter without in any way affecting the utility of the machine as a universal milling tool. The part performed by the indexing apparatus is to automatically control the division and also the change and return of the table. This permits of an operative attending to several machines at the same time, and it is on this basis of calculation that a saving of 50 per cent is estimated. When not required the automatic gear cutter is removed from the machine.

In appearance the apparatus is like an inclosed gear box, which is attached to the table next to the dividing head. It is connected to this dividing head by a train of wheels, while a further train on the opposite side operates the table feed. The apparatus is driven by a belt from the countershaft, which necessitates the disconnecting of *any* existing feed driving arrangement. This means that the coun-

tershaft must be provided with a longer shaft to take an extra pulley. Ordinarily, the pulley on an indexing apparatus is run at 400 to 600 revolutions per minute. The width of this pulley is 6 inches, which corresponds with that of the belt-tightener rolls.

One of the photographs forwarded shows the indexing apparatus stowed in a metal box, and the other shows the apparatus at work

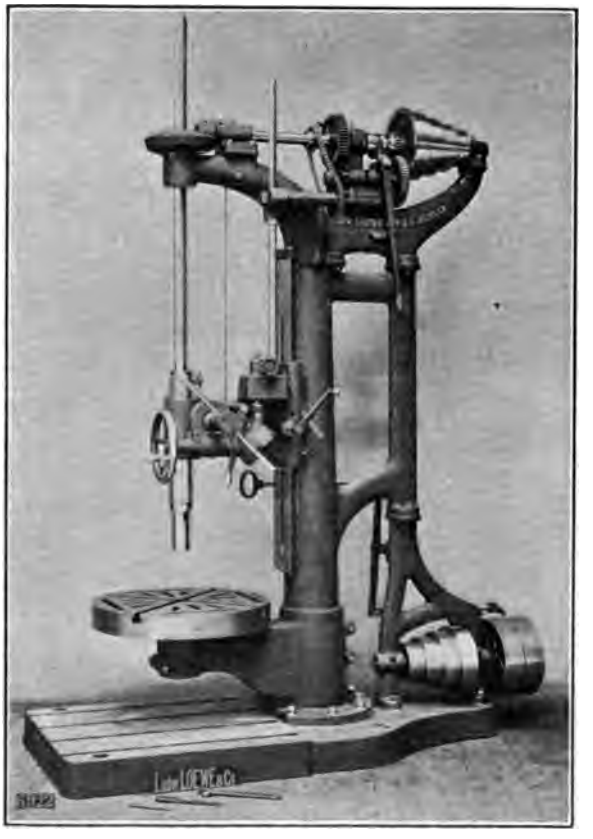

FIG. 3.—Loewe vertical drilling machine; equipped with ball bearings. Change of feed effected by gear box.

attached to universal milling machines. The apparatus can be readily detached from the machines and is capable of use with many of the well-known standard makes of millers of the day.

WORKING MECHANISM.

The automatic feed of the table with quick return is brought about by means of the change wheels which connect the apparatus with the table feed, and the ratio of these change wheels determines the amount of feed per revolution of work arbor. The return speed of the table is eight times that of the working. The travel of the table

is regulated by adjustable dogs, which are attached to an adjustable horizontal bar and strike against a fixed stop. The bar is connected to the reversing lever in such a manner that by changing the position of a screw, the direction of feed and return, respectively, can be reversed, enabling either right or left hand cutters to be used. The automatic division takes place at the end of the returning motion. The driving wheel of the train between the apparatus and the dividing head makes exactly one revolution each time.

FIG. 4.—Loewe sensitive drill.

Any division which is possible with the available change wheels can be made. The ends of both spindles of the apparatus are detachable, so that they can be turned to suit the bore of the change wheels.

The apparatus can only be used on a machine provided with a dividing head and change wheels and is intended for work which is not required to turn while the cutter is in operation. The spindle of the dividing head can be arranged horizontally, vertically, or tilted to any desired angle. The apparatus permits of adjusting to universal milling machines of various makes, provided the general dimensions are approximately the same as the machines made by Ludwig Loewe & Co. A. G.

The apparatus is made in two sizes, one 9¼ inches long, and one 10½ inches long, the latter being a heavier pattern and capable of heavier work. I understand that the tool is used on both the Becker-Brainard and Cincinnati types of milling machine. When in use on these two American machines the pulley of the apparatus will be in front, while the reversing bar will be on the back.

The Loewe Works are putting forth special efforts on their drills, The line includes vertical, sensitive, and radial drills.

The sensitive drills are operated either with or without motor. Ball bearings are used. It is claimed that the sensitive drills have twice the capacity of ordinary drills with reference to the diameter of the holes to be bored, and can be worked with four to five times the speed. Four spindle speeds are obtained even with the two-step cones. An automatic pump is utilized for cooling work.

The Loewe radial drill is equipped with long square slides on the column. All levers are within reach of the operator, and the drive is positive. All gears are covered.

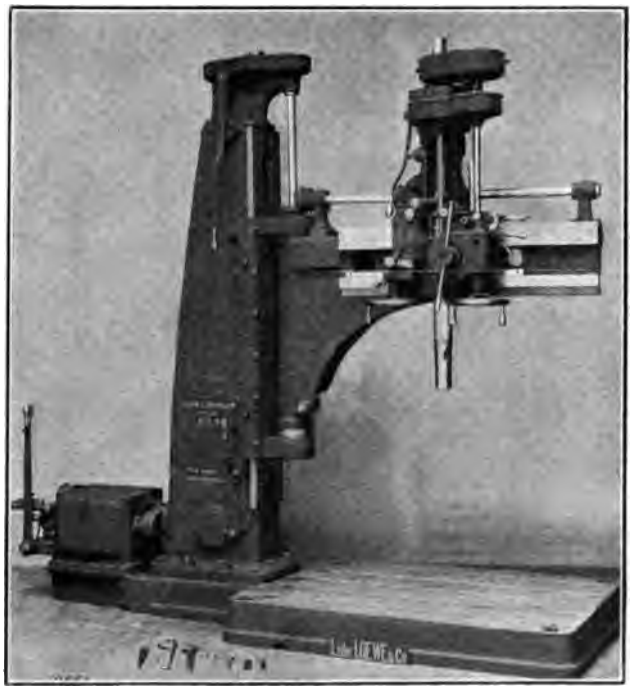

FIG. 5.—Loewe radial drill.

THOROUGH LABORATORY WORK.

There is a physical and chemical laboratory at Loewe's, which is very complete, and it is because of the thoroughness of this laboratory that the firm is able to ship a good many castings to America. These castings are mostly cylinders, in which absolute certainty regarding the material is a prerequisite to its acceptance. I find that the firm is casting many cylinders for automobiles and locomotives.

The German state railways require that for all locomotive cylinders for state locomotives a bar shall be cast with the cylinder and of the same metal. This bar must be broken only in the presence of

a government inspector, and by him is subjected to physical and chemical test. Not only are the usual physical strains registered, but the bar is shaved and photographs taken under highly magnified conditions of the physical make-up of the metal. The very best thought and attention is devoted to this laboratory work, with the result that Loewe is able to speak advisedly as to the character of the castings.

During the year 1907 the Loewe Works turned out net castings to the extent of 6,195,552.3 kilos. Of this amount 3,234,662.6 kilos were absorbed by the Loewe shops, and 2,960,889.7 kilos were taken over by customers. The quantity exported amounted to 100,620.5 kilos.

The actual average rates of wages which have been paid in the foundry department are as follows:

	Marks per hour.		Marks per hour.
125 hand molders	0.777	34 cleaners (picklers)	0.648
32 machine molders	.647	6 apprentices	.141
45 core makers (men)	.717	125 workmen (varied help)	.481
20 core makers (women)	.33		

While the Loewe managers naturally rate their own products high, it is interesting to note that they concede the most advanced form of chucking machines, radial drills, upright drills, circular and universal grinding machines, planers, and the bevel-gear shaping machines are to be found in America.

CHEMNITZ DISTRICT—REINECKER SHOPS.

There are a great many machine-tool houses in Germany. Many are mediocre, others are doing good work, while there are a few which may be classed as really dangerous competitors of many American machine-tool firms. If any American manufacturer doubts this statement his attention is invited to the Chemnitz district, and in particular to the establishments of J. E. Reinecker, Wanderer Works, Schubert & Salzer, and Werkzeugmaschinenfabrik Union vorm. Diehl. The products turned out by these four establishments approximate, in several instances, to first-class American work. Both Reinecker and Wanderer have sold some tools in the United States, and the writer has personally observed a Reinecker backing-off lathe in service in a Rochester shop.

Reinecker is doing conspicuously good work on milling machines for heavy-duty character. His shops control the Hugo Bilgram (American) patents for Germany.

Through the courtesy of officials of the Reinecker works I was afforded an opportunity to inspect the shops on March 18 and 19. On the first day the works were closed down by reason of a holiday, but I very gladly accepted of the invitation to walk over the plant. On the second day I accompanied Mr. Ponds through the shops. It

was represented to me that Reinecker was working 1,971 men, of whom 1,837 were workmen, and 134 various employees. I was informed that Reinecker's employees work 10 hours a day, and 50 pfennigs per hour is an average wage for skilled tool men. The men, it was said, are fairly well contented. There is a men's court for the trial of grievance cases. The total number of machine tools installed at Reinecker's is 1,195.

SHOP EQUIPMENT.

Among the American machine tools in service at Reinecker's, I observed the following:

Norton Grinding Company, Worcester, Mass., grinders; Fish Machine Company, Worcester, and Foslick Machine Tool Company, Fitchburg, Mass., radial drills; Prentice Bros. Company, and F. E. Reed Company, Worcester, Mass., lathes; Baush Machine Tool Company, Springfield, Mass., radial drills; Jones & Lamson Machine Company, Springfield, Vt., turret lathes; Brown & Sharpe Manufacturing Company, Providence, R. I., complete line of tools; Potter & Johnston Machine Company, Pawtucket, R. I., automatic turret, chucking and turning machines; New Haven Manufacturing Company, New Haven, Conn., lathes; Pratt & Whitney, Hartford, Conn., thread milling machines; C. C. Bradley & Son, Syracuse, N. Y., hammer; Gould & Eberhardt, Newark, N. J., shapers and vertical drill presses; Hugo Bilgram, Philadelphia, Pa., gear planers; William Sellers & Company, Philadelphia, Pa., water grinders; Newton Machine Tool Works (Incorporated), Philadelphia, Pa., cold saw machines; The Acme Machinery Company, Cleveland, Ohio, bolt machines; Gisholt Machine Company, Madison, Wis., turret lathes; The Binsse Machine Company, Newark, N. J., horizontal boring mills.

The above comprises about all the machine tools in use by Reinecker. There may have been others, but I am inclined to think that the list is fairly complete. J. H. Williams Company, of Brooklyn, N. Y., have supplied most of the drop forgings, and the time-checking system is from the International Time Reckoning Company, also an American concern. The measuring tools have been supplied by both Brown & Sharpe Manufacturing Company, Providence, R. I., and the L. A. Starrett Tool Company, Athol, Mass.

The firm of Sargent & Greenleaf, Rochester, N. Y., supplied many of the locks and padlocks of the new buildings, and the workmen's chests are likewise provided with locks of this type. I understand that the majority of the American tools listed above were purchased 7 or 8 years ago, or longer. Alfred Herbert (Limited), of Coventry, England, and Richards, of Broadheath, are also represented at Reinecker's, the former with turret lathes, and the latter with an open-side planer.

PRINCIPAL TOOLS PRODUCED.

The principal tools manufactured by Reinecker consist of milling machines, engine lathes of all sizes and description, vertical boring mills, mandel lathes, milling and tap lathes, grinding machines, and

relieving lathes. The last-mentioned machine is probably one of the best turned out by Reinecker, and I do not hesitate to say it is in a class by itself. This tool is capable of handling all kinds of milling cutting. So far as I know there is only one American machine tool which can compete with this particular Reinecker machine. On the other hand, there are a number of shapes of milling cutters which Reinecker makes for milling-worm gear, which are known as "relieved worm-gear cutters," and are not known to the trade in America. These special Reinecker cutters are adapted to the worm-gear milling machines. I am inclined to believe that Reinecker can be put down as one of the first houses in Europe in gear cutting.

Other good machines made by this firm are universal milling machines and heavy slab milling machines, and I understand that there is a big business done in these slab millers to locomotive works. From my own observation I can attest to the presence of these slab millers in a number of the best locomotive shops. Reinecker has built a horizontal and vertical milling machine, with direct connected motor, 7 meters long by 4 meters wide. This firm is building an automatic spur-gear cutter with single milling cutter and a developing machine for cutting spur gears; also a worm-gear milling machine for cutting worm gears and spur gears, as well as spiral gears. Reinecker's relieving lathe possesses merit, and it is this machine which has been sold to do service in America.

I observe that Reinecker, in common with many other German firms, is using steel for these cutters furnished by Gebrüder Bohler & Co., A. G., of Vienna. In the case of the Bilgram bevel-gear planers, above referred to, the developments at Reinecker's permit of a ratio of 1 to 1 up to a ratio of 1 to 10. The same machine cuts wheel as well as pinion.

THE WANDERER WORKS.

The works of the Wanderer Company (Wanderer Fahrradwerke, formerly Winkelhofer & Jaenicke A. G.) are located in Schönau, a suburb of Chemnitz. They center attention largely on milling machines, and employ about 1,200 men. I am inclined to think these works have no superior in Germany in the medium-size milling machines. From personal observation I find that the millers of this firm are in service in some of the best shops on the Continent. In addition to milling machines, the Wanderer works turn out a really fine gear cutter, and it was this latter type of tool which was purchased some time ago by an American house for use in connection with automobile construction. This particular tool differs from the standard American machine of the same type in using worm-gear cutting in lieu of the straight single cutting. I am informed that 40 to 50 per cent of this firm's output is for foreign orders.

PRESENCE OF AMERICAN TOOLS.

I found the following makes of American machine tools in service in the Wanderer shops:

Warner & Swasey, Cleveland, Ohio, turret lathes; Fitchburg Machine Works, Fitchburg, Mass., high-speed lathe; Brown & Sharpe Manufacturing Company, Providence, R. I., grinding machines; Pratt & Whitney, Hartford, Conn., lathes; Prentice Bros. Company, Worcester, Mass., drills; Landis Machine Company, Waynesboro, Pa., grinding machines.

The tools manufactured at the Wanderer works are plain milling machines of the column type as well as of the Lincoln type, universal milling machines, automatic gear-cutting machines, and universal dividing and spiral head and accessories.

In the plain milling machine of Lincoln type there are four principal types, and with No. 2, 3, and 4 machines of this class there is supplied a vertical milling attachment. These four machines are referred to as "plano milling machines," or what might be understood as millers in the form of planers. In the plain milling machines of the column type there are three sizes. The universal milling machine is made by Wanderer in three sizes, the working surface of table of the largest size measuring 48 by 9⅞ inches. This machine weighs 3,850 pounds. Naturally it is made for heavy work, the spindle being back-geared for this purpose.

GEAR-CUTTING MACHINES.

The automatic gear-cutting machines are designed for service with spur gears up to 400 and 700 millimeters. The construction is based on a generating system, and the aim is to avoid any inaccuracy of indexing, such as results in the case of those machines working heated material with ordinary module cutters. For cutting wheels of different diameter and different number of teeth of a given pitch, only one worm cutter with straight flanks is used. The shape of the teeth is produced by the wheels and cutters rotating simultaneously. As there is no return of cutter slide, the cutter is working at an increase. This affords an output which is regarded as greater than from machines of the automatic type using ordinary cutters. How much truth there is in this latter statement is largely a matter of individual judgment. The Wanderer works supply 43 change gears with each machine, with division cuts from 10 to 100, and from 100 to 400 prime numbers excluded, worm wheels, both for right and left hand, single or multiple, threaded worms, are alike cut with these machines, and do not require any change of mechanism.

No. 1 machine of the automatic gear-cutting type will handle work as small in diameter as 10 millimeters, and a maximum diameter of

400 millimeters. No. 2 machine will serve wheels varying in diameter from 30 to 700 millimeters. No. 1 machine weighs (gross) 1,200 kilos, and No. 2 machine (gross) 1,600 kilos.

SHOP ARRANGEMENTS.

The shop arrangements at the Wanderer works are excellent. There is good light, and the ventilation and sanitary arrangements are of the best. The shop is essentially first class, and illustrates in a large degree German progress and development in machine-tool construction. A relief fund of over 100,000 marks is maintained for the benefit of the employees, and this fund is being added to yearly. The interest is utilized in behalf of the workmen. These works maintain also a mutual sickness fund corporation, and pay what is said to be the highest relief per cent in Germany, namely, an amount equal to three-fourths of the invalid's wages, besides paying for medical treatment and medicine. A large dining room, supplied with ample heating shelves to insure warm dinners, is provided for the workmen. This dining hall is used by men whose homes are at considerable distance from the shops.

WERKZEUGMASCHINENFABRIK UNION, AT CHEMNITZ.

Werkzeugmaschinenfabrik Union (vorm. Diehl), Chemnitz, is a comparatively small plant, employing not more than 250 men, but the noteworthy fact is that this firm is centering its efforts on a few designs. The boring mills turned out by this concern comprise 13 sizes. The table of the largest will admit of any ordinary-size work being swung between supports. These boring machines are combined horizontal borers and milling machines. The tools have certainly obtained a good hold in Germany, for I have repeatedly seen the word "Union" on borers in the best German shops. In addition to boring machines, planers and lathes are manufactured, but the tendency is to combine on the boring machine, since it is this last-mentioned tool which represents in the highest degree the skill of this firm.

SCHUBERT & SALZER, AT CHEMNITZ.

There are at least three firms in Germany who are turning out a good grade of shaping machine. One of these firms is Schubert & Salzer, whose plant is one of high order. Machine tools, however, constitute only a portion of the output, as one department is devoted to the manufacture of cash registers.

In the machine-tool line Schubert & Salzer are building lathes, both of the engine and turret types. Automatic turret lathes are also made, and in addition, boring machines and milling machines. *The shaping* machine, however, has earned for this firm the high

reputation it now enjoys. I can not say that the machine is better than the one turned out by Ludwig Loewe & Co., but it appears to be a first-rate tool, so much so that it is doubtful if a foreign machine of the same type, unless possessing superior merit, could successfully compete in Germany. The automatic shaper recently developed at the works of J. E. Reinecker, and previously referred to, is a tool which even Schubert & Salzer have found desirable to employ. Unless an American firm can develop on a standard shaper and produce some strong points in advance of the Loewe and the Schubert & Salzer shapers the German field may be regarded as covered. This statement merely emphasizes what has been previously said, that if American machine-tool houses expect to do business in Europe they must keep in advance of the best machinery houses here. This can only be accomplished through superior technical knowledge and workmanship.

WAGES AND WORKING HOURS.

Schubert & Salzer, I was informed, are paying some of their best tool men not more than 36 pfennigs per hour. This applies more especially to men who are working on milling machines. I expressed some surprise to one of the officials at this low rate of pay, and in the course of our conversation he declared that the machine-tool workmen of Chemnitz are, in his opinion, the best in Germany. He also admitted that they are the "cheapest"—that is, the worst paid.

The rate of wages in the Chemnitz district appear to be considerably less than in the Berlin or Rhine territories—in fact, the wages at Chemnitz seem to be lower for high-class machine work than in any other part of Germany.

BIERNATZKI WORKS.

Biernatzki & Co., Chemnitz, are turning out two sizes of automatic gear-cutting machines for spur, spiral, and worm wheels. I understand that there is a fair trade in these machines in the United Kingdom. The cutter has a hob, and is set at any angle to the wheel blank, so that as the cutter slide feeds forward the teeth of the wheel are cut exactly straight to its axis, the cutter and head carrying the work spindle being connected by gearing. Their motions are independent, and the movements of the cutter and wheel blank are exactly regulated so as to give one revolution of the wheel blank while the cutter is making just so many revolutions as teeth are desired to be cut in the wheel.

The self-acting feed of the cutter slide is driven by a leading screw connected directly with the large worm wheel by conical gears, feed rod, and worm. The worm runs in oil and the cutter, cutter slide, and headpiece are operated by one motion.

It is claimed that the machine is simple of construction and easy to handle, and that only one cutter is required for each wheel containing different numbers of teeth, provided they are of the same pitch. This arrangement, it is claimed, greatly reduces the cost of cutters, making it only about one-half as compared with machines with which it is necessary to use a set of 8 or 14 cutters for each pitch. The form of tooth is declared to be absolutely and theoretically correct for wheels for any number of teeth, and not correct by leaps only, as is the case when a set of cutters is to be used for each pitch. It is claimed as an advantage that being formed by the same cutter the teeth of all wheels of the same pitch that contain different numbers of teeth are formed equally thick, at an equal height of tooth, and that the gears cut by this machine work without backlash.

It is declared that no previous nicking or preparation of the solid blank on a dividing machine is required, the machine doing its own dividing automatically during the process of cutting. There is another advantage claimed from the fact of several teeth of the cutter working at once, thus increasing the capacity as compared with the ordinary spur wheel cutter. It is claimed that the capacity is still further increased by the dividing device working still forward instead of backward and forward.

Biernatzki & Co. are making two styles of the above machines, known as No. 1 U. and No. 2 U. The capacity and dimensions are as follows:

	1 U.	2 U.
Minimum diameter to be cut spur gear.....inches..	$1\frac{1}{4}$	$1\frac{1}{4}$
Minimum diameter to be cut spiral gears up to 45°.....do....	2	2
Maximum diameter to be cut.....do....	27	39
Maximum face to be cut spur gears.....do....	$11\frac{3}{4}$	$11\frac{3}{4}$
Maximum face to be cut spiral gears up to 45°.....do....	$7\frac{7}{8}$	$7\frac{7}{8}$
Pitch spur gears in cast iron.....D. P. do....	$3\frac{1}{2}$	$3\frac{1}{2}$
Pitch spur gears in steel .....do..do....	$4\frac{1}{2}$	$4\frac{1}{2}$
Pitch spiral gears (45°) in cast iron.....do..do....	$4\frac{1}{2}$	$4\frac{1}{2}$
Pitch spiral gears (45°) in steel.....do..do....	5	5
Diameter of index wheel.....inches..	20	$24\frac{1}{4}$
Diameter of work arbor.....do....	$3\frac{1}{4}$	$3\frac{1}{4}$
Diameter of cutter.....do....	$1\frac{1}{16}$	$1\frac{1}{16}$
Speed of countershaft, revolutions per minute.....	350	350
Size of pulleys on same.....	$9\frac{7}{8}\times3\frac{1}{8}$	$9\frac{7}{8}\times3\frac{1}{8}$
Approximate net weight of machine.....kilos..	1,600	1,750
Approximate net weight of countershaft.....do....	75	75
Approximate gross weight together.....do....	2,000	2,150
Floor space required by machine.....do....	71×55	71×57

The machine is regularly supplied with the following equipment: Oil pump and tank; change gears for cutting all numbers of teeth up to 100, and all from 100 to 250 except the prime numbers; 1 worm hob of diametral pitch 6 long series; 1 cutter arbor $1\frac{1}{16}$-inch diameter; 1 mandrel $1\frac{1}{4}$-inch diameter for *blanks;* 1 countershaft; tables of gear ratios and the necessary wrenches.

LEIPZIGER WERKZEUG-MASCHINENFABRIK.

The Leipziger Werkzeug-Maschinenfabrik (formerly W. von Pittler A. G.) is one of the few firms in Germany which approximates closely to specializing in machine tools. At present this firm is engaged in making what is commonly referred to as the "Pittler turret lathe" and, in addition, automatic pin and stud lathes, full automatic screw lathes, and semi-automatic screw lathes. The Pittler turret lathe is so nearly a Potter & Johnston machine of the same type as to make it difficult to distinguish between the two makes. The Potter & Johnston machine is an American tool made by that firm in Pawtucket, R. I. The turret of the Pittler lathe, which, it is pointed out, differs from the regular turret device, is claimed by the Leipziger firm as an original construction. The Leipziger Werkzeug-Machinenfabrik is working at present about 250 men. German machine-tool houses find it difficult to specialize in the American sense for the reason that Germany does not offer a sufficient market to make specializing pay. In America, where the market is large, it is possible to find sufficient business to permit of specializing, but a German machine-tool house to do this must have recourse to foreign markets. Restricted number of tools built by the Pittler firm shows that the tendency in Germany, provided the market can be obtained, is to specialize. There are several milling machine-tool houses which are endeavoring to reach the specializing stage, and there is a gear-cutting house near Chemnitz, Hermann Pfauter, which is practically making only one tool—gear-hobbing machines.

TYPICAL GERMAN PLANT.

The Pittler establishment pays its expert tool men between 70 and 80 pfennigs per hour, when working on piecework. About the only American machine tools in these works are grinders from the Brown and Sharpe Manufacturing Company, Providence, R. I.; Norton Grinding Company, Worcester, Mass., and Landis Tool Company, Waynesboro, Pa. The Pittler establishment may be regarded as ultra-German, and although the managing director admitted that drills made in America are better than drills turned out in Germany, still he was not very enthusiastic in his statement. He declared his firm does not have to use American measuring instruments nor American machine tools other than grinders. On the whole his firm rather prides itself on its independence of American connections.

The Leipziger Werkzeug-Maschinenfabrik (formerly W. von Pittler, A. G.) may be regarded as among the best German makers of lathes, turret and automatic lathes.

ERNST SCHIESS WORKS.

The machine-tool works of Ernst Schiess, known as Ernst Schiess Werkzeug-Maschinenfabrik, A. G., is one of the best plants of its kind in Europe. The efforts of the Schiess shops are confined largely to turning out tools of the heaviest class, and there can be no question that Schiess is capable of building machines of the largest make. This firm made the boring lathe which produced the finished 45-meter long shaft exhibited by Fried. Krupp at the Düsseldorf Exposition, 1902. The writer has observed Schiess tools, not only in Germany, but in many of the leading manufacturing plants of other countries of Western Europe, and has been impressed by the high character of the products of this firm. Aside from the good workmanship on the tools, there is probably no better casting work in Germany than can be found in the Schiess foundry.

The Ernst Schiess Works have been in existence since 1866, and became a limited company in 1906. The works are located at Düsseldorf. The firm is interested in a Russian undertaking which builds machine tools, and is known as the Riga Iron Foundry and Machine Works (Limited). In the spring of 1908 the Düsseldorf shops of Ernst Schiess were employing about 1,000 people, and, while not working overtime, the shops were busy. A large proportion of the orders in hand at this period were reported as being for export, and included a number of boring mills for turbine work at Russian shipyards.

The Schiess plant covers about 13½ acres, half of which is occupied by the shops. In the period 1869 to 1906 the Schiess Works built about 9,500 machines for varied work. For the most part the products of the firm are of the large-size tools.

The Ernst Schiess firm produces practically all its own castings, and pieces up to 50 tons in weight are readily cast. This establishment rather prides itself on freedom from foreign tools. In all there are about 400 machine tools, comprising all the various machines which might be expected in works of this sort. Among the tools installed are 160 lathes varying from 5 to 39⅜ inches (130 to 1,000 mm.) height of centers, among which are some for cutting lead screws up to 55 feet 9 inches (17 meters) in length; horizontal turning and boring mills, 32 planers, some of which can plane 13 feet 1½ inches (4 meters) square by 39 feet 4½ inches (12 meters) long; 7 shapers, 8 slotting machines, 20 radial and pillar drills, 24 horizontal boring, drilling, and milling machines, the largest of which is for pieces 9 feet 10 inches (3 meters) by 19 feet 8 inches (6 meters); 30 various milling machines, 17 gear-cutting machines, 8 bevel-gear planers, grinding machines, and a number of special machines.

The principal tools manufactured by the Schiess firm comprise *lathes, planing*, shaping, and slotting machines, drills, boring, drill-

ing, and milling machines, punches and shears, straightening and bending rolls, cold and warm saws, screwing, pipe-threading, and cutting-off machines, grinding machines, eccentric, spindle, and hydraulic presses, and wheel-molding machines. The firm also makes special tools for iron and steel work, railway wheel and axle work,

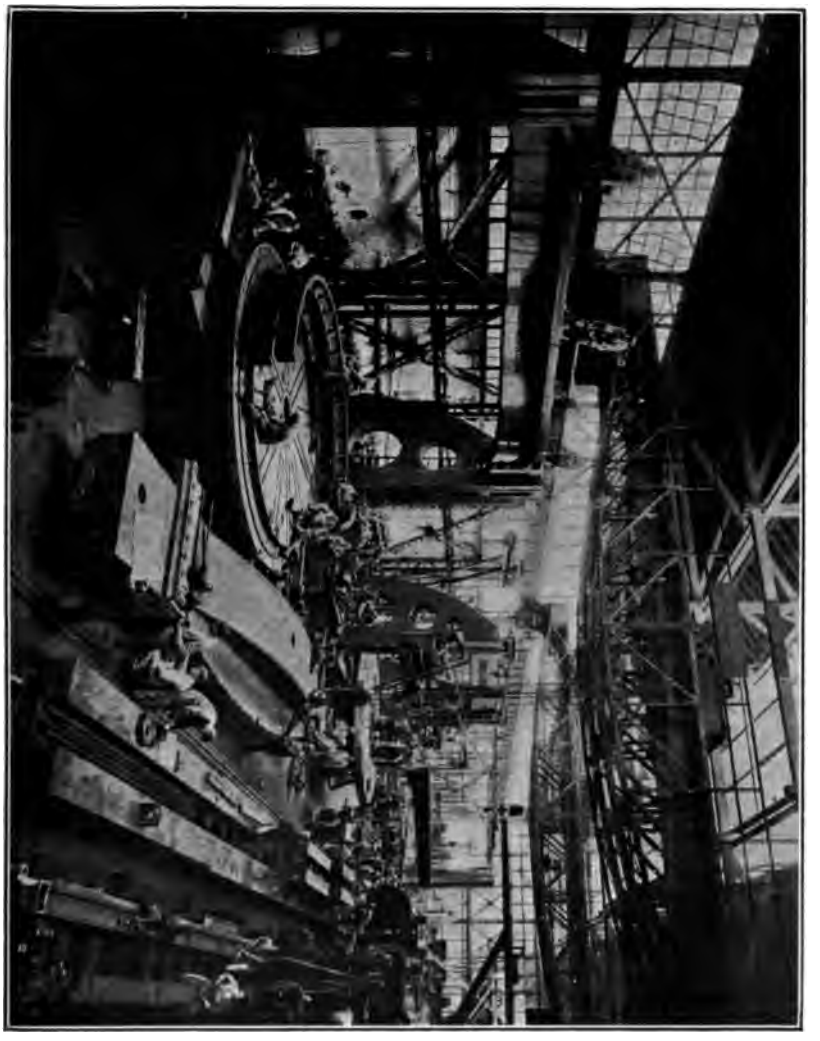

FIG. 6.—Interior view Ernst Schiess machine-tool works, Düsseldorf, Germany.

roll makers, boiler works, tube rolling mills, locomotive traction and wagon works, and arsenal machinery. Inasmuch as this establishment is one of the best in Germany, it is sufficient to say that the equipment is fully in keeping with what one would expect to find in first-class shops. I understand that Schiess was invited to make

tenders to one of our American steel works firms which desired to install armor-plate working tools, but the Düsseldorf works found that the duty of 45 per cent could not be overcome. The great majority of the heavy tools in the Krupp works at Essen are of Ernst Schiess make, which fact is an indication of what these machines are capable of doing.

WORKS OF DE FRIES & CO.

The machine-tool plant of de Fries & Co., A. G., Düsseldorf, is a thoroughly representative German establishment. The number of men employed at the time of my visit on March 5 was 750. The character of work turned out is noteworthy. This firm not only manufactures machine tools, but imports for sale some of the best makes of American machine tools. A representative of the firm visits the United States once a year, and wherever a late type of American machine tool can be procured possessing merit, it is obtained by the Düsseldorf firm. I found in the De Fries shops machine tools of American make from the following houses:

Charles G. Allen Company, Barre, Mass., drill presses for blue-chip steel (patent); Becker-Brainard Milling Machine Company, Hyde Park, Mass., millers; Norton Grinding Company, Worcester, Mass., grinders; Brown & Sharpe Manufacturing Company, Providence, R. I., millers; Pratt & Whitney, Hartford, Conn., thread millers and lathes; Gleason Works, Rochester, N. Y., gear cutters; Gould & Eberhardt, Newark, N. J., millers; LeBlond Machine Tool Company, Cincinnati, Ohio, lathes and millers; American Tool Works Company, Cincinnati, Ohio, drill presses; Bardons & Oliver, Cleveland, Ohio, turret lathes.

These shops are paying on an average 70 pfennigs per hour to good tool men. All work is piecework, and a workman is not considered desirable unless he can make at least 65 pfennings per hour.

WAGES AND HOUSING OF OPERATIVES.

The following table indicates the rate of wages in pfennigs paid skilled men in the De Fries shops (100 pfennigs=1 mark=23.8 cents):

	Pfennigs per hour.		Pfennigs per hour.
Lathe men	65	Vise men, assembling department	70
Planer hands	70	Molders	75
Milling-machine men	70	Core makers	65
Boring-mill hands	70	Carpenters	70
Grinding-machine men	65	Pattern makers	80
Foremen	80	Forge men	80
Assembling department hands	70		

The 300 machine tools constituting the equipment of De Fries & Co. are operated by approximately 200 machinists, constituting an average of 1½ machines per man. Twenty per cent of the 750 men

employed represents unskilled labor. The workday is reckoned at 10 hours and the average wages paid for unskilled labor is 38 pfennigs per hour.

This firm, in common with other leading establishments in Germany, aims to do something for the welfare of its men, and houses owned by this company are rented at as low as from 150 to 350 marks ($35.70 to $83.30) per annum. This rental covers from two to three rooms. There is a sick fund for the care of sick workmen, the dues of which amount to 3 per cent of wages, 2 per cent being paid by the workmen and 1 per cent by the De Fries firm. It should be explained, however, that no dues are levied on wages earned in excess of 5 marks per day, and that the percentage levied applies only to wages up to 5 marks per day. In addition to the sick fund there in an old-age fund and a fund for invalids, the dues being shared equally by the firm and workmen.

LIMITED USE OF AMERICAN TOOLS.

Director Roper, of this firm, is not inclined to believe that the immediate prospects for a large business in American machine tools on the Continent are promising. He regards German competition as very close, but emphasizes the fact that many tools of American make are still enjoying the preference, especially the tools of such firms as have been known in Europe for many years. On such items as twist drills, dies, taps, and reamers Director Roper is of the opinion that the sale of such articles is largely a matter of price, quality, and reputation. He says there is no question as regards the general good construction of American machines, but finish and wormanship very frequently give occasion for complaints. The American machine, he says, does not last so long as one of German make, which is another obstacle the selling agent has to meet in his arguments. It is Mr. Roper's opinion, however, that ingenious features do not count for so much when offering a tool to a prospective European buyer as does the real merit of the machine.

At the De Fries shops American measuring tools are in high favor. It is the writer's observation that American measuring tools are generally recognized on the Continent as being of more practical value, and better in almost every way than those of European make.

The principal line of tools manufactured by the De Fries & Co. firm comprise horizontal boring, drilling, tapping, and milling machines; self-acting, sliding, surfacing, and screw-cutting lathes with long segmental nut attached to bed; vertical keyway cutting and slot-drilling machines; horizontal forging machines; horizontal bending and forming machines (bulldozer); centering machines; sawing machines; crank-shaft lathes, and tool-room grinders.

The De Fries & Co. horizontal boring, drilling, tapping, and milling machines are composed of the following parts: One base plate, 1 bed, 1 upright horizontally adjustable on the bed, and 1 carriage vertically adjustable on the upright. The driving is effected from a

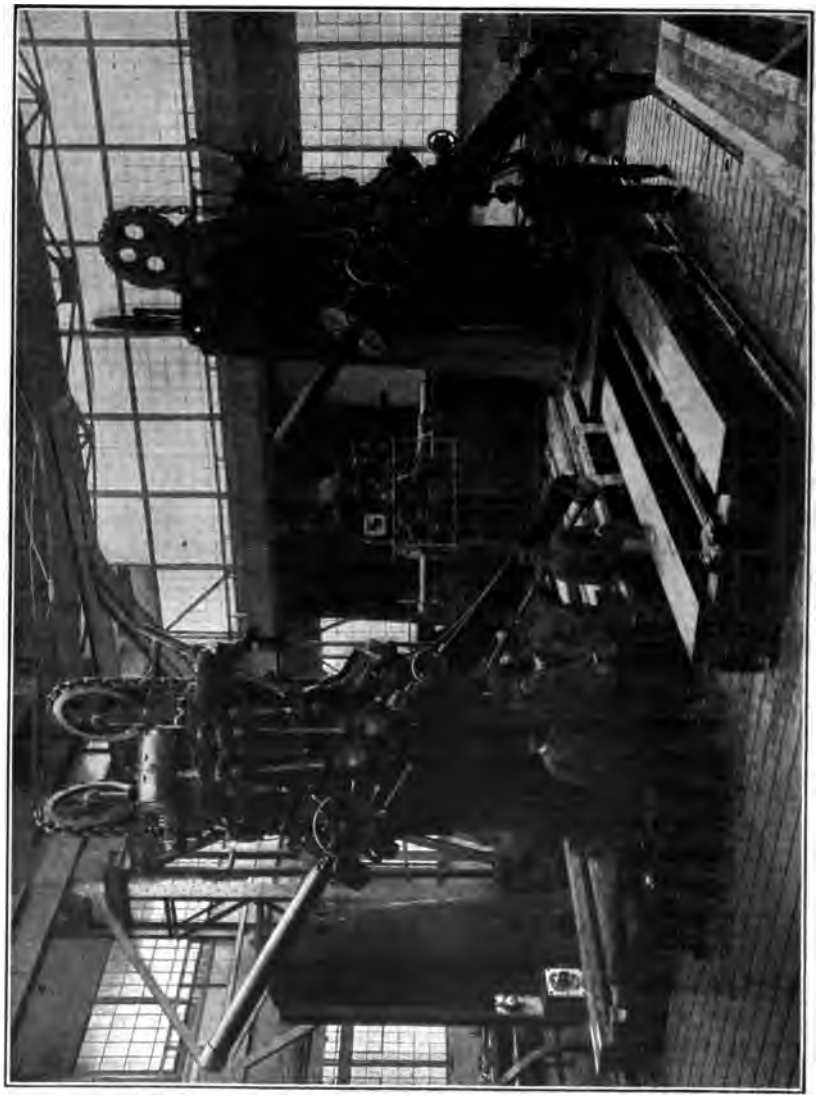

FIG. 7. De Fries & Co.'s horizontal boring and milling machines.

countershaft by cone pulleys onto a shaft running the full length of the bed, which drives, by means of bevel gearing, a vertical shaft carried by the upright. The power is then transmitted through bevel wheels to the driving shaft on the carriage. From this shaft

the spindle sleeve is driven direct either through pinion and face-plate wheel or through equal gears giving, in conjunction with the back gears and cone pulley, a large number of speeds to the spindle. This spindle is made of forged steel, has two keyways running its full length and is driven by and slides in a long rotating sleeve; its outer end is bored conically to receive the boring bars. The end thrust is taken by hardened steel and white metal washers. The sleeve carrying the spindle runs in bearings of large diameter and length, the front one being of hard phosphor bronze externally conical and adjustable for wear. It is provided with an externally conical bush at its outer end for the purpose of taking up the wear of the spindle. During milling operations the spindle and sleeve are locked together to prevent end motion. The large driving wheel is keyed to the spindle sleeve and is also used as a face plate having T slots for the purpose of mounting a large milling and facing heads or other tools for special work. The variable self-acting boring feeds are obtained from a wheel keyed to the sleeve through a nest of gears onto the main horizontal feed shaft, which drives, through reversing gears, worm, bevel or spur gearing the rack for the smaller and the feed screw for the larger sized machines. The changes are effected by hand wheels and draw keys in the nest of gears in the feed box. By means of a hand wheel placed close to the face plate, and suitable clutches, the spindle can be traversed either quickly, or through worm gearing, slowly for adjustment and hand feed. The milling feeds are driven from the nest of gears, main feed shaft and reversing gears onto a sleeve revolving loosely round the vertical feed shaft in the upright. This sleeve can be coupled up to the rotating nuts on the fixed vertical and horizontal screws in the upright and bed, i. e., either direct or vertical or through the vertical shaft and bevel gearing for horizontal feeds. For the quick horizontal and vertical power traverses of the upright and carriage the same arrangement as previously described for the feed motion is used; in this case the sleeve is driven from the main driving shaft on the carriage through gearing. Precautionary arrangements prevent the horizontal and vertical traverses from being in action at the same time and the feed and quick traverse motions can not be used simultaneously. It is also impossible to put the quick traverse into gear until the handwheel for the fine adjustment is disengaged so that the latter can not rotate rapidly and injure the attendant. A platform for carrying the workman is attached to the carriage and all motions for engaging, disengaging, or reversing the feeds, quick traverses, and hand adjustments can be controlled from this position.

DIMENSION PARTICULARS.

The main dimensions for the horizontal boring, drilling, tapping, and milling machines for size numbers 3, 4, 5, and 6 are as follows:

	No. 3.	No. 4.	No. 5.	No. 6
Diameter of spindle	5½″	6⅝″	7½″	9½″
Traverse of spindle	3′ 11¾″	4′ 7″	4′ 11″	6′ 6¾
Maximum height of spindle above base plate	7′ 2½″	8′ 6″	9′ 10″	11′ 5½″
Minimum height of spindle above base plate	15¾″	17¾″	19¾″	23¾″
Horizontal adjustment of upright along bed	9′ 10″	9′ 10″	13′ 1″	16′ 4″
Diameter and width of largest step on cone pulley	19 by 3¾″	19¾ by 4⅛″	21½ by 4½″	24½ by 5¼″
Diameter and width of fast and loose pulleys on countershaft	19¾ by 4¼″	19¾ by 5½″	21½ by 6¼″	25½ by 7½″
Number of feeds	6	6	6	8
Maximum feed per revolution of spindle:				
Boring ... mm.	3.2	3.6	4.3	5
Milling ... do.	9.0	10.0	11.6	13.6
Minimum feed per revolution of spindle:				
Boring ... do.	0.22	0.23	0.25	0.28
Milling ... do.	0.6	0.63	0.68	0.75
Number of speeds:				
A	20	38	30	30
B	24	36	40	40
C	16	24	24	24
Fastest and slowest speeds per minute	104 to 1.59	100 to 0.84	98 to 0.68	110 to 0.51
Horsepower of motor at slowest speed ... B.	8	10	12	16
Horsepower of motor ... C.	8	10	12	16
Weight without stay and without base plate, unpacked, approximate ... pounds.	31,000	46,000	68,200	116,000
Extra weight for every additional 19¾-inch vertical traverse, approximate ... pounds.	840	990	1,320	2,020
Extra weight for every additional 19¾-inch horizontal traverse, approximate ... pounds.	840	990	1,320	2,140
Size of standard base plate	11′ 10″ by 6′ 7″	13′ 1″ by 8′ 6″	16′ 4″ by 10′ 2″	19′ 8″ by 13′ 1″
Weight of base plate, approximate ... pounds.	10,670	15,400	26,400	57,200
Size of turntable with cross adjustment	4′ 11″ by 4′ 11″	4′ 11″ by 4′ 11″	6′ 7″ by 6′ 7″	6′ 7″ by 6′ 7″
Weight of turn table with cross adjustment, unpacked, approximate ... pounds.	8,360	8,360	11,000	11,000

VALUE OF VERTICAL MACHINE.

The novelty of the vertical keyway-cutting and slot-drilling machines lies largely in the method of operation. The drill, which is of the same diameter as the width of the groove to be cut, is adjusted so that it rests on the work; the indexes are then set to suit the depth and length of the slot to be milled and the machine started. After the hole has been bored to its full depth the vertical feed is automatically disengaged and the longitudinal traverse of the carriage simultaneously thrown into action. The carriage then feeds along the bed milling out the full width and depth of the slot in one cut until the required length has been reached, when the feed is automatically disengaged and an electric bell rung to notify the workman of the completion of the operation.

As indicating the capacity of this machine De Fries & Co. give the following figures: Keyway, 5¾ by 1 by ⅜ inches=6½ minutes; keyway, 9⅞ by 2 by ⅝ inches=32 minutes.

The main dimensions of these vertical keyway-cutting and slot-drilling-machines are:

	No. 1.	No. 2.		No. 1.	No. 2.
Maximum width of slot machined in one cut....	1″	2″	Minimum ditto....mm..	0.047	0.066
Maximum depth of slot machined in one cut....	⅜″	⅝″	Cross traverse of table.....	3½″	4¾″
Depth of slot machined in several operations varying according to the width, up to a maximum of.....	1 5/16″	3″	Maximum distance from top of table to bottom of carriage.....	15¾″	20″
Maximum length of slot..	31½″	3′ 3¼″	Minimum distance from top of table to bottom of carriage.....	4¾″	9½′
Maximum diameter of work.....	6″	13¾′	Diameter of largest step on driving pulley.....	15¾″	23¼″
Length of bed.....	4′ 3″	6′	Width of each step.....	2½″	3½″
Diameter of spindle.....	1½″	2⅜″	Number of steps.....	5	3
Vertical traverse of spindle.	4¾″	8″	Number of speeds.....	5	6
Number of positive feeds.	3	3	Revolutions of countershaft per minute.....	230	335 and 250
Maximum vertical feed per revolution of spindle, mm.....	0.075	0.109	Diameter and width of driving pulleys on countershaft.....	15¾ by 3½″	23½ by 4″ 17¾ by 4″
Minimum ditto....mm..	.019	.026	Space required.....	6′1″by3′4″	7′11″by5′5″
Maximum horizontal feed per revolution of spindle, mm.....	.178	.266	Weight, unpacked, approximate.....pounds..	3,410	7,700

CUTTING LATHES.

The De Fries & Co. self-acting, sliding, surfacing, and screw-cutting lathes permit, it is claimed, screws of any length being cut accurately to pitch. It is maintained at the De Fries Works that on the ordinary type of screw-cutting lathes the thread to be cut is a copy of the guide screw, which can not be claimed to be absolutely correct. The contention is that a screw is a continuous helical curve on a cylinder and its pitch can not be accurately cut by means of a dividing arrangement. It is especially difficult, it is pointed out, to cut long screws accurately, the amount of inaccuracy increasing with the length, and these defects of the guide screw are naturally copied on the screw to be cut.

On the De Fries & Co. lathe in place of the customary guide screw a segmental nut fastened to the bed is used with which a worm or short screw mounted on the carriage engages. The segmental nut is cut by means of a patented apparatus in conjunction with a fine measuring machine in order to obtain a mathematically exact pitch. It is claimed that screws cut on this lathe are of almost the same exactitude, independent of their length.

The segmental nut is fastened directly to the bed and is brought very near to the center of the lathe, nearer it is claimed than is the case with an ordinary guide screw, which especially in the case of gap lathes is necessarily brought well to the front. The nut being attached to the bed is not so easily affected by the temperature as a guide screw, it is claimed, which latter is free to extend or contract within fairly large limits, this error being transmitted to the screw operated upon. For screw cutting the long segmental nut is used in connection with a short worm, this being put in and out of gear by a lever on the right of the apron.

The bed is provided with V guides for the carriage and tailstock. The headstock has a wide cone pulley and disengaging back gearing which is protected by wheel guards. The main spindle is hollow and ground to size at its bearings, which are cylindrical and revolve in long phosphor-bronze bushes, these being externally conical and adjustable by means of lock nuts. The end thrust is taken by hardened steel and white metal washers. The bearing surfaces of the top rests are long and wide. The swivel slide is provided with a scale to permit it being adjusted to any angle; all screws have indexes for fine adjustment. The sliding and surfacing motions can be worked automatically or by hand. The automatic longitudinal and transverse motions of the carriage are effected by means of a feed shaft, the driving being transmitted from the spindle by gearing. A nest of gears is placed on the bed underneath the headstock, through which three different feeds are obtainable by means of a drawrod. The countershaft is arranged for two speeds and is provided with pulleys for open and crossed belts. All feeds are reversible by lever placed at the bottom of the apron. The carriage can be traversed by hand along the bed by handwheel, rack, and pinion. The gears for the headstock are of cast steel, the pinions being of hard bronze.

LATHE DIMENSIONS.

The main dimensions of the De Fries & Co. lathes above described, covering size-numbers 1 to 7, inclusive, are as follows:

	No. 1.	No. 2.	No. 3.	No. 4.
Height of centers	5 5/16″	7″	8½″	9⅞″
Width between centers	3′ 3¼″	3′ 3¼″	3′ 3¼″	3′ 3¼″
Length of bed	6′ 5″	6′ 11½″	7′ 4½″	8′ ½″
Bore of spindle	⅞″	1″	1 3/16″	1⅜″
Maximum diameter to be turned over bed (swing)	13½″	16¼″	18½″	22″
Maximum diameter to be turned over carriage (swing)	8¼″	10″	11¾″	14″
Maximum diameter to be turned in gap (swing)	19″	22″	27½″	35½″
Width of gap from face plate	5⅛″	5⅞″	7⅝″	10″
Width of gap piece	3¼″	4″	4¾″	5⅞″
Pitch of threads to be cut.....per inch	2-64	2-64	2-64	2-64
Number of threads	33	33	33	33
Pitch of threads to be cut.....mm	0.25-6	0.25-6	0.25-6	0.25-6
Number of threads	37	37	37	37
Number of back gear ratios on headstock	1	1	2	2
Maximum ratio of gearing	1:8	1:10	1:12	1:14
Number of steps on cone pulley	5	5	4	4
Number of speeds	20	20	24	24
Diameter of largest step on cone pulley	7⅛″	9½″	11″	13¾″
Diameter of smallest step on cone pulley	3¾″	4⅝″	6⅛″	8¼″
Width of belt on cone pulley	2⅜″	2¾″	2⅞″	3⅜″
Diameter and width of driving pulleys on countershaft	[a] 11⅞″ by 5½″	[a] 11⅞″ by 5⅞″	[a] 13¾″ by 6½″	[a] 15½″ by 7¼″
Revolutions of countershaft per minute	150,225	150,225	120,200	120,200
Space required	7′ 1″ by 2′	7′ 6″ by 2′ 6″	8′ ½″ by 2′ 6¼″	8′ 8½″ by 3′ 1½″
Weight, unpacked, approximate, pounds	1,455	1,895	2,840	4,955
Extra weight with gap.....pounds	200	265	395	465
Extra weight for every additional 19¾ inches width between centers, approximate.....pounds	110	145	175	245
Less weight, if without sever-cutting *arrangement*, approximate..pounds	155	190	265	350

[a] 3 pulleys.

	No. 5.	No. 6.	No. 7.
Height of centers	11⅞″	14″	15¾″
Width between centers	3′ 3¼″	3′ 3¼″	3′ 3¼″
Length of bed	9′ 3¼″	10′ 2″	11′ 6″
Bore of spindle	1⅞″	2 3/16″	2 5/16″
Maximum diameter to be turned over bed (swing)	26¾″	31″	2′ 11¼″
Maximum diameter to be turned over carriage (swing)	17¼″	20¾″	24½″
Maximum diameter to be turned in gap (swing)	3′ 5¼″	3′ 11¼″	4′ 5″
Width of gap from face plate	12¼″	14¼″	16½″
Width of gap piece	7/8″	8¼″	10¼″
Pitch of threads to be cut ... per inch	2–64	2–64	2–64
Number of threads	33	33	33
Pitch of threads to be cut ... mm	0.25–6	0.25–6	0.25–6
Number of threads	37	37	37
Number of back gear ratios on headstock	2	2	2
Maximum ratio of gearing	1:15	1:16	1:18
Number of steps on cone pulley	5	5	6
Number of speeds	30	30	36
Diameter of largest step on cone pulley	16½″	19¾″	22″
Diameter of smallest step on cone pulley	9¾″	11¼″	12¼″
Width of belt on cone pulley	4″	4½″	5½″
Diameter and width of driving pulleys on countershaft	[a] 17¾″ by 4½″ [a] 27″ by 4½″	[a] 19¾″ by 5″ [a] 27½″ by 5″	[a] 21½″ by 5½″ [a] 32½″ by 5½″
Revolutions of countershaft per minute	115,170	120,170	100,150
Space required	9′ 10″ by 3′ 7½″	10′ 10″ by 4′ 3½″	12′ 2″ by 4′ 5″
Weight, unpacked, approximate ... pounds	6,380	8,800	11,770
Extra weight with gap	400	440	530
Extra weight for every additional 19¾ inches width between centers, approximate ... pounds	350	440	550
Less weight if without sever-cutting arrangement, approximate ... pounds	440	550	685

[a] 4 pulleys.

The location of the De Fries Works is at Heerdt, just outside of Düsseldorf. There is plenty of good country around the workmen's homes, and the factory is not so far away from the city to make it inaccessible. A pleasant tram ride of about twenty-five minutes carries one from the center of the city across the fine new Düsseldorf bridge at this part of the Rhine and direct to the company's offices.

THE BORSIG WORKS.

At Tegel, on the outskirts of Berlin, is located the vast machinery plant of A. Borsig. There are 5,300 men employed by this firm. The writer is personally acquainted with practically all the leading German machinery works, and he has no hesitancy in saying that it is his firm belief that the Borsig organization stands in the first rank in Germany in point of shop efficiency. I visited the Borsig Works on February 12 and again on February 18. In no other German plant have I seen, in certain instances, such advanced forms of shop method as are apparent here, and the American who at the outset wishes to become acquainted with German progress in machinery can see nothing finer in this line than is offered at the Borsig shops.

The shop managers at Borsig's have learned wonderfully well how to get the maximum capacity of work out of tools. There could undoubtedly be reductions made in the force employed, but there can be no mistake about the tools working at practically 100 per cent efficiency. It would be refreshing for some of our American

manufacturers, who believe that we alone understand the term "shop efficiency," to take a walk through these shops, and I believe that a glimpse of the workings of this particular plant would cause a realization of what there is ahead of America in foreign competition. To make this clearer it should be known that the methods in vogue at Borsig's are practically those followed in similar large works in the United States. Herr Neuhaus, who has charge of the shop works at Borsig's, spent three years, I understand, at the Allis-Chalmers plant in Milwaukee, and I learn that this same gentleman while there had much to do with the designing of the big Allis-Chalmers engine which is now in operation at the Ludwig-Loewe Works in Berlin.

EFFICIENCY OF GERMAN MACHINERY.

To be sure, Borsig stands in a class all by himself. He is a user of machine tools and not a maker, like the Ludwig Loewe Aktien-Gesellschaft. Borsig demands the highest grade of tools obtainable, and in particular he wants tools which will give him both high-grade results and speed. He uses planers, gear cutters, lathes, milling machines, and practically the entire gamut of tools required in locomotive construction, boiler work, etc. His plant fairly bristles with high-grade American machine tools, but only those of the best American make. The manufacturer's agent who has a tool of late construction and superior merit to offer should have no hesitancy in going to such a firm, and this statement applies not only to Borsig but to every other first-class German house; in other words, let there be no misunderstanding on the part of our machine-tool makers—the Germans are turning out to-day machinery of a wonderfully high standard. This standard demands high-grade tools for its production, and the market exists here for the American machine-tool makers who have a superior tool to offer.

Borsigs state that considerably over one-half of what they produce is for foreign countries, and quite recently this foreign trade has been considerably augmented by substantial orders from French territory. The French have not at all been inclined, for many years, to patronize German houses, but the merit of German production has forced itself even on the French buyer, and at this writing Borsig, for example, has in hand a considerable number of locomotives for French railways.

Probably the greatest danger which the American manufacturer has to meet abroad is enhanced shop efficiency. The Germans are not economical in man labor, but they are learning. They are realizing more and more the possibilities in tools, and in every particular the German workman is improving. I know of the Germans using two men with a machine, where the American designer never con-

templated that more than one man should be employed. They know better than this at Borsig's, and there are other German plants which would not be guilty of the same practice.

MACHINE TOOLS IN USE—ONLY ONE OF ENGLISH MAKE.

In a plant such as Borsig's it is natural to expect to find only the best machine tools, but there are a great many old tools in service. I understand it to be the policy, however, to gradually replace all old machines with tools of late make. In only one instance did I observe an English-made tool in service at Borsig's; all other tools were either of American or German build. The American makers represented are:

Potter & Johnston Machine Company, Pawtucket, R. I.; G. A. Gray & Co., Cincinnati, Ohio; Prentice Brothers Company, Worcester, Mass.; Garvin Machine Company, New York City; J. E. Snyder & Co., Worcester, Mass.; Brown & Sharpe Manufacturing Company, Providence, R. I.; Norton Grinding Company, Worcester, Mass.; Gisholt Machine Company, Madison, Wis.; and the Niles Tool Works, Hamilton, Ohio.

There may have been some other American tools in the Borsig shops, but if so the writer did not observe them. Roughly estimated, I should say there were at least 30 Gray planers in service. These tools are liked very much; and, in one instance, it was observed that a Gray planer was being utilized to do grinding work. In this case the grinder was attached to the overhead crossbar and from there was operated by a belt. The work, which was secured to the planer bed, was drawn back and forth as in a planing operation. Canvas screens were utilized to protect the machine from the dust occasioned by the grinding operation.

The German tools in use at Borsig's may be regarded as coming more or less in competition with the American machines in service, and among the German firms drawn on I noticed the following:

Ludwig Loewe & Co., Berlin; Deutsche Niles-Werkzeugmaschinenfabrik, Oberschöneweide bei Berlin; Ernst Schiess Werkzeugmaschinenfabrik, and De Fries & Co., Düsseldorf; J. E. Reinecker, Chemnitz and Dortmunder Maschinenbau, Dortmund. There were also some grinding tools from one of the Schmaltz firms of Offenbach-on-Main.

WORK AT THE BORSIG SHOPS—ONLY AMERICAN PNEUMATIC TOOLS USED.

The Borsig shops are turning out at present locomotives, hydraulic presses, steam engines, ice machines, boilers, and compressers. The tendency is to specialize. Not long ago this establishment dropped the building of gas engines. This plant also manufactured tools to a limited extent, but does not engage in that work now, except for its own use. Aside from the locomotive work, its specialty may be said to be hydraulic presses. Bo[illegible] recourse to a special air-testing machine, by means of [illegible] tools. Forg[illegible] for sale are

actually tested to ascertain the expense of operation. This fact may not be known to some of our American manufacturers, and it is interesting to observe that Borsig is only using at present American pneumatic tools. There are pneumatic tools made in Germany, but there was no hesitancy in stating to me at Borsig's that the American pneumatic tools were purchased because they are considered superior to those of German design. How long this will continue is problematical. There seems to be little question but that the American pneumatic-tool manufacturer can meet the German in prices, if needs be, for some time to come, but so long as American tools remain superior no reduction is necessary. It is noteworthy, however, that recent German designs of pneumatic tools are showing marked improvement.

WAGES PAID.

In the forgings department two workmen, picked out at random, were questioned by the shop manager for my benefit as to the wages they are earning. One man replied 5 marks ($1.19) per day on an eight-hour basis, while the second stated he was making about 7 marks ($1.66) per day. The director declared the first man was not earning as much as the shop permitted; in other words, it is possible to earn 7 marks per day if a man puts forth the effort.

EXTRA SUPPLIES KEPT UNDER LOCK.

Borsig's plant is very careful to keep all its stock under lock. I found a section of a street between the press shop and the smith shop set apart and guarded by locked screen doors, both at the street ends and at every opening from the buildings. In this street the stock was assorted and placed in bins. It was explained to me that this prevented the men from using material at random. In some instances Borsig's have found that flaws developed in material in service, and upon examination it was ascertained that the material used was not what the shop prescribed. The assumption was naturally that the workmen having had access to the material which would work up more easily had used the latter. It is to prevent any such recurrence that the firm now carefully guards all material that is worked up. Very great care is taken at this establishment in its physical and chemical analysis of metals, and this is in striking contrast to the method followed by many of our American firms, where the laboratory plays but a small and unimportant part.

SIEMENS AND HALSKE-SIEMENS-SCHUCKERT WERKE.

Prominent among the great electrical plants of the German Empire are the Siemens and Halske-Siemens-Schuckert Werke. The standard of work turned out is very high and, in general, is unexcelled on

the Continent. This company employs more than 25,000 people, and of this number fully 6,000 are carried on the rolls of the Wernerwerke, at Nonnendamm. The total number of employees in all the Nonnendamm shops of this company approximate 13,000. The rate of wages paid by this firm is based largely on piecework, and for the summer of 1907 is illustrated by the following table (mark=23.8 cents):

	Average weekly wages.	Average hours per week.	Highest earned per man per week.	Hours of work per week.
	Marks.	*Hours.*	*Marks.*	*Hours.*
Lathe hands	46.12	57½	66.66	66
Vise men	39.90	56½	58.59	63
Drill-press men	33.85	57¾	45.00	67½
Planer hands	36.55	53¾	47.73	55½
Machine laborers	34.10	60½	52.56	72
Machine porters	28.85	63½	40.25	66
Tool-lathe makers	44.00	55½	49.20	61½
Tool-vise hands	41.87	60½	48.18	66
Milling-machine hands	39.33	60½	54.68	67½
Tool grinders	34.63	56¾	50.15	66

The working hours given in the table should not be regarded as normal, since they include overtime; forty-nine and one-half hours represents the normal week's work.

At the time of my visit to Nonnendamm (February 15) the electrical business in Germany appeared good. At Wernerwerke there was at least one year's work in sight, and for the two years previous its shops were working on night and day shifts. Overtime had been discontinued four weeks previously, but night work was shortly to be resumed in at least two departments.

SHOP EQUIPMENT.

The high grade of work turned out by Siemens and Halske-Siemens-Schuckert Werke makes it imperative that only machine tools of merit be employed. The character of the work produced not only demands many expert workmen, but the employment of tools affording very accurate results. In the machine-tool branch of Wernerwerke only American and German tools were observed. The American manufacturers whose tools are in service at Wernerwerke are, so far as I was able to note, fully comprised in the following list:

Brown & Sharpe Manufacturing Company, Providence, R. I.; Warner & **Swasey and Cleveland** Automatic Machine Company, Cleveland, Ohio; Cincinnati **Milling Machine** Company and the Cincinnati Machine Tool Company, Cincinnati, **Ohio; Landis** Tool Company, Waynesboro, Pa.; Becker-Brainard Milling **Machine Company,** Hyde Park, Mass,; Garvin Machine Company, New York **City; Dwight Slate** Machine Company and the Hartford Machine Screw Company, **Hartford, Conn.**; Pearson Machine Tool Company, Chicago, Ill.; Niles **Tool Works, Hamilton,** Ohio; and Sloan & Chase Manufacturing Company, **Newark, N. J.**

In the tool-hardening department the only ovens found installed were those of the American Gas Furnace Company, of Elizabeth, N. J. The opinion is held here that these furnaces are superior to any now made in Germany. The German tools installed at a plant such as Wernerwerke may be fairly taken to represent those tools which, in their respective types, are in active competition with the leading American machines. The German tools in use were, for the most part, millers, drill presses, lathes, gear cutters, and threading machines. There were also quite a number of presses in service. Among the German makes represented the following firm names were observed:

Malik & Walkow, Beling & Lübke, and Ludwig Loewe & Co., Berlin; Schubert & Salzer Maschinenfabrik, and Wanderer Fahrradwerke vorm. Winkelhofer & Jaenicke, Chemnitz; E. Kirkneis, Aue in Sachs (Saxony), and Kirchner, Leipzig.

THE PRODUCTION OF MILLING MACHINES.

Noteworthy in this last list are the milling machines of the Wanderer Fahrradwerke of Chemnitz, and the opinion has been expressed by German experts that the products of this firm are pressing some of our best American millers closely. The millers of the Chemnitz establishment undoubtedly have merit, and certainly possess much form. It would not be too much to say that these Saxony tools represent in a very high degree the best that is being turned out by German tool manufacturers. From statements made it would seem that the Chemnitz firm is selling its tools much cheaper than American manufacturers demand for the same type of machine; in fact, some of the figures quoted are so considerably less as to make it advisable for American manufacturers of milling machines to watch this German development closely.

ATTENTION PAID TO SANITATION—ARRANGEMENTS FOR MEALS.

The writer has seen few manufacturing plants, either in Europe or America, which can excel in design and in attention to sanitation these great works of Siemens & Halske-Siemens-Schuckert. At Wernerwerke there is not a dark room anywhere in the entire establishment where men and women have to work. There is good light, and plenty of it. The air is pure, and the whole atmosphere of the place is healthy, morally and physically. The State requires that certain essentials in the way of insurance and pensioning be complied with, but the firm has gone further than this, and has made it worth while for a man to remain in its employ. It is true that the firm has had its own troubles in the handling of workmen, but these troubles are happily of the past. I found at Wernerwerke that it is the practice to feed the employees during the noon hour. There are different

eating rooms for different classes of employees, and good meals are supplied at from 15 to 35 pfennigs (100 pfennigs=1 mark=$0.238). It is not to be asumed that this cost covers the expense, but it insures keeping the employees together, and obviates some of the hardships which would ensue naturally in the case of a plant located at a considerable distance from the workmen's homes.

SAFEGUARDS FOR WORKMEN.

In the Nonnendamm shops, I was forcibly impressed with the scrupulous attention paid to the regulations safeguarding workmen. The German inspection requirements are that all machine tools for cutting, stamping, and pressing purposes be protected by screens. We are accustomed in America, in many instances, to see a cutting machine which is operated by the foot. When working rapidly accidents occur. This is guarded against in the German shops. Not only is the cutter screened to the very limit of practicability, but in order to insure that the workman's hands are off of the plate, two levers must be pulled. This means that both the right hand and the left hand must be on the levers, and away from the plate. It means a little slower operation, a little more cost in production, and a fractional shade lower per cent in a shop efficiency, but it means safety for the workman, and a better protection of life.

WELFARE WORK.

There are few firms in Germany which have done, or are doing, more in the welfare line than the Siemens & Halske-Siemens-Schuckert Werke. This establishment has had to combat prejudice on the part of some of the working societies, and in particular on the part of the socialists, who, it is stated, are in general opposed to the establishment of homes and any very close ties between manufacturer and employee. I have seldom seen such scrupulous care and attention paid to the welfare of employees in the matter of food and other necessities as this firm provides at nominal figures for its people. In common with others, this establishment is compelled by the German law to make certain provision in the matter of insurance. They have gone further than this, and have devoted a degree of attention and care to their employees which may be regarded as philanthropy of the most practical form. In one year alone, October 12, 1906, to October 11, 1907, there was paid out in pensions and other sums to widows and orphans of employees 261,143 marks. This sum covered eleven works. The payments included 22,403 marks to 27 men for old age, 139,086 marks to 303 persons for various pensions, and 2,725 marks to women employees. The sum of 65,147 marks was paid to

449 widows of workmen, 25,271 marks to orphans, while during the year there was paid out 1,272 marks in final payments to widows who remarried. In cases of distress 2,371 marks was paid to men pensioners and 5,633 marks to widows of workmen. As a summary, there was paid in one year as follows:

	Marks.
Pensions	161,449.21
Current support	90,418.42
In final payments on remarriage	1,272.30
Sums paid in cases of distress	8,003.25
Total	261,143.18

Siemens & Halske started their welfare work October 12, 1872, with a capital of 142,500 marks. Later on this firm was united with the Siemens-Schuckert Werke, and on October 12, 1897, the Siemens family gave from their private funds toward the welfare capital 1,000,000 marks. From time to time special sums have been contributed by the firm aggregating a total of 650,000 marks. January 1, 1904, Schuckert & Co. gave from their workmen's fund, as a natural result of combining with Siemens & Halske, the sum of 912,500.94 marks. Up to October 12, 1907, the sum given by Siemens & Halske, exclusive of sums from the Schuckert pension fund before the year 1904, amounted to 5,327,511 marks. The total of both funds up to October 12, 1907, amounted to 6,381,750.38 marks.

EXTRAS AND PENSIONS.

It is the practice of the firm to give yearly certain sums to this welfare work for each workman who has served for more than one year, and these extras amount for men to 30 marks per annum, and for women 18 marks. The total sum averages 450,000 marks per annum.

The pension paid to employees depends upon the number of years employed, and is indicated by the following table:

Years employed.	Men.	Women.	Years employed.	Men.	Women.
	Marks.	*Marks.*		*Marks.*	*Marks.*
10	270	162	23	621	372.6
11	297	178.2	24	648	388.8
12	324	194.4	25	675	405
13	351	210.6	26	702	421.2
14	378	226.8	27	729	437.4
15	405	243	28	756	453.6
16	432	259.2	29	783	469.8
17	459	275.4	30	810	486
18	486	291.6	31	828	496.8
19	513	307.8	32	846	507.6
20	540	324	33	864	518.4
21	567	340.2	34	882	529.2
22	594	356.4	35	900	540

Where a man has served 25 to 35 years, his widow receives 50 per cent of her husband's pension; where the service has been 10 to 25 years, she receives 33⅓ per cent, and where the service has been 5 to 10 years, 25 per cent. Together with this support for widows, a sum of 8 marks per month is paid to each workman's legitimate child under 14 years. This sum may also be paid to children over 14 years during such period as they are learning a profession, or while preparing for any other vocation. Parents who were dependent upon the deceased can, so long as the widow is supported from the fund, receive support equal to that which children receive, i. e., 8 marks. Should, however, no widow's pension be paid, the total support equal to that of the widow's support is paid. The sums paid to dependents must not, when totaled, exceed the pension paid to the deceased which he received at the time of his death, or what he would have received had he lived.

The committee having charge of the capital of both funds and the fixing of pensions and support is arranged in common by a committee consisting of some representatives from the clerks, women clerks, workmen, and from the workwomen of both firms. These representatives are chosen. Those entitled to vote and those from whom selection can be made are those employees who on the voting day, October 12, have completed five years with one or the other firm, or who have been employed collectively by both firms for five years. Every 100 legitimate voters can choose one representative. The voting takes place once every two years on October 12. The chairman of the commission must be a member of the Aufsichtsrath (board of examiners of the firm) or of the directorate, or one of the head clerks provided with special authority.

OTHER WELFARE WORK.

Siemens & Halske-Siemens-Schuckert Werke, in addition to the pension work indicated, further aid their workmen in various ways. For example, sick workers obtain upon request an additional aid, amounting to about 5 marks per week, from the factory, which is aside from the sick allowance paid out of the so-called "sick cash" and from the support eventually due out of the "aiding union." In some particularly meritorious cases still larger allowances are made, as in the case of long illness in the family. Several hundred children are every year sent out to the so-called "vacancy colony" at the expense of the firm. In the case of deceased employees, special payments are sometimes made upon request to cover the cost of interment.

The welfare work in providing dwellings for the workmen at the firm's branch works in Nürnberg has proved satisfactory. In Berlin and its environs, I am told, the work has not been so satisfactory.

owing, perhaps, to the fact that metropolitan workmen are somewhat restless and are more subject to the influence of the Socialistic party. I am advised that the firm is about to arrange for a savings bank similar to the one now in vogue at the Krupp works at Essen. The exact form of government of this savings institution has not yet been decided upon.

COOPERATIVE SOCIETIES.

All works of Siemens & Halske-Siemens-Schuckert have placed free at the disposal of cooperative societies kitchens and cellars for canteen managements, and, in addition, the firm has assigned dining rooms on the top floors of the buildings, where warm meals are served. On the cellar floors cold food and drinks are served. The management of these societies is under the regulation of the firm, and it is incumbent upon the societies' managements to fully care for the rooms assigned to them.

It is arranged that the requisite contrivances for the managements of the canteens for heating and cooking, as well as lighting purposes, are only loaned to the societies, and the latter must keep the equipment in good order. In case of the necessity of enlargements in the present canteen arrangements proposals for such enlargements are to be submitted for the approval of the firm.

Bills are not incurred to any extent. In fact, it seems to be the rule to pay cash daily to all merchants who supply these canteens. All check payments are compared and must be verified by three responsible drawers, and for this purpose a certain formula must be complied with. The factory provides the requisite steam for heating without charge, but the societies must take care of the cost of water, gas, and steam for cooking, as well as for electrical power at 11 pfennigs (pfennig=¼ cent) per kilowatt hour; the charge for water per cubic meter is 10 pfennigs; gas per cubic meter, 13 pfennigs; steam per kilo, 35 pfennigs. Water, gas, and power are measured by a built-in enumerator, and steam by pressure of average consumption. Smoking is not only prohibited in the works, but is forbidden to strangers. In case of failure of steam, gas, or water arrangements, or electric current, the firm does not guarantee to undertake to interfere. The societies have to look out for this. The factory management is always empowered to make inspection and to assure themselves that the work of the societies is carried on in an orderly manner. The societies are bound to deliver good, warm food at moderate prices, well prepared, to all employees and work people. The hours for meals are regulated by the work-shop management, and no changes can be made except when sanctioned by the factory.

In case the societies fail to fulfill their duties, the factory management may undertake to make good all contracts. The license for all

beers and wines is entered under the name of one of the company's officials. The personnel of the societies is engaged by one of the head officials of the societies, but the engagements must be sanctioned by the works' management. The society employees can not enter the premises earlier than 5 a. m. and must leave not later than 6.30 p. m.

The food supplied is of an excellent character. Menus are varied for each day, and are charged for at two rates. The portions at 15 pfennigs ($0.0357) consist usually of some kind of a vegetable soup and beef or bacon. The portions at 25 pfennigs ($0.0595) consist mostly of some kind of a roast or sausage, with potatoes or some other vegetables.

BENRATHER WORKS.

The short-sighted policy of some American firms in letting go foreign business during times when home orders are exceptionally good, only to discover that the business once lost can seldom be regained, was never better exemplified than in the rise of the Benrather Maschinenfabrik, A. G., located at Benrath. It is not so very long ago that American machinery firms did an excellent business in Europe in hoisting and transport machinery. The foreign connections were allowed to suffer during times of exceptional demand at home, and it was under such circumstances that the Benrather works came to the front.

Nearly 1,500 men are employed. This firm makes a specialty of cranes and hoisting machinery, and about 30 per cent of its product is for export. Work was in progress on very heavy cranes for Belfast, Ireland, and also for Beardmore's yards in Scotland. Some of the best business this firm receives is from points in the United Kingdom. It is an interesting fact that one of the designers at the Benrather works spent eighteen months in the designing offices of a leading American firm.

The floating cranes turned out by Benrath swing through 360 degrees. One of these Benrath floating cranes, with a lifting capacity of 110 tons, was supplied to the Japanese naval authorities for service at Tokyo, and a similar crane of 150 tons lifting capacity and 200 tons testing capacity was, in the spring of 1908, being erected in the Belfast yards of Harlan and Wolff. About the same time the construction of a third crane similar to the above was undertaken by Benrath for the harbor commission of Bremerhaven.

There was recently constructed at Benrath an erecting shop, which I estimated as having a length of about 1,200 feet. It is one of the best shops of its kind that I have seen in Germany.

LIVING CONDITIONS AND WAGES.

The Benrath works have united with three other firms and together form a limited company for the erection of dwelling houses for the

use of the workmen. In all 84 houses have been built, 10 houses of which comprise two flats of 4 rooms each, 42 houses comprise two flats of 3 rooms each, and 32 houses comprise three flats of 3 rooms each. For the use of unmarried workmen this last company provides 190 beds, and the price for board and lodging is 1 mark (mark=23.8 cents) per day.

Milk is sold at the Benrath works during working hours at the price of 5 pfennigs per 0.2 liter. Sandwiches are sold at the price of 15 pfennigs. The daily consumption of milk at the Benrath shops amounts to about 200 liters. The number of men employed here is approximately 1,200. The Benrath plant provides an invalid and old age pension, and sees to the maintenance of sick workmen and their families.

The rate of wages paid by the Benrather Maschinenfabrik, A. G., in 1907, covering 1,140 employees, is seen from the following table:

Workmen.	Under 3 marks.	3 to 3.50 marks.	3.50 to 4 marks.	4 to 4.50 marks.	4.50 to 5 marks.	5 to 5.50 marks.	5.50 to 6 marks.	6 to 6.50 marks.	6.50 to 7 marks.	7 to 7.50 marks.	7.50 to 8 marks.	8 to 8.50 marks.	8.50 to 9 marks.	9 to 9.50 marks.
Straightener				2		3								
Sawer				2		1	1	1						
Center pointer	5	4	3	5										
Stock keeper		1	1											
Riveter		1	1			3	6	3	1		1			
Rivet heater	18		1											
Die holder	1	1	3	5	3									
Shear operator				1	2			1						
Thread cutter				2			1							
Cutter					1									
Foreman						2	7	12	4	11	3	1		
Tracer					2	1	3	9	4					
Planer	1	2		2	2	1	3			1	3	3		
Shaper	1			1	2	1	2			4				
Milling cutter			1	1	3	5	5							
Grinder							1							
Packer			1	2										
Shunter					1									
Locomotive driver														
Turner														
Pattern maker					2	2	3	1						
Building joiner					2	5	3							
Carpenter				1		1	3							
Lathe operator		1	4	4	5	4	16	20	27	22	11	2	2	3
Saddler							1	1						
Borer		2	4	20	1	4	2	3	2			1		
Horizontal borer						1	2			1	4	2	2	2
Machinist						1	1							
Stoker					1	1	4	3						
Motor attendant		1			1	2								
Wireman					2	1	1	1	1					
Armature winder								1						
Mechanics				1			1							
Erectors				2	5	7	5	4	2	3	3	1		
Crane drivers				4	4		1							
Fitter	5	4	7	26	62	66	40	17	6	2	1			
Smith				1	3	4	6	4	4	2	5			
Striker			1	18	12	5	2	1	1					
Press operator				1		1	1							
Brick layer				1		3	6	4						
Rough laborer				3	1									
Painter			3	8	7	3	1							
Brazier					1	2	1	1						
Day worker	13	18	47	69	56	21	5	2	2		1			
Apprentices	59													
Total	103	35	75	182	184	153	134	109	68	46	32	10	4	5

DEMAND FOR AMERICAN MACHINE TOOLS—ALLEGED DEFECTS.

In February, 1908, the machine-tool business in Germany was quieter than at any time during the previous 12 months; the large tool makers were for the most part building only for stock, and, generally speaking, the situation was regarded by the leading commercial interests in Berlin as a reflex of the monetary conditions in America. While the conditions were quiet in the German shops they were, comparatively speaking, more active than those in the United States. This statement the writer based on his personal observations covering many of the machine-tool houses in the United States during the period from December 18, 1907, to January 11, 1908.

I have been at considerable pains to ascertain what criticisms, if any, are leveled against American machine tools, and have directed my inquiries not only to the men who sell but to those who actually use the tools. I regard the statements of the men in the shops as of great value, and have been struck by the coincidence of opinion regarding what might be termed essential faults. The shopmen say there is too much cast iron used in levers and wheels. The German workman, they point out, is rather heavy and clumsy, and not as deft and shifty as the American. When the average German workman turns a wheel or pulls a lever he is apt to do it in a heavy fashion, and will often throw his whole weight on the machine, particularly if he finds a little resistance, with the result, very often, of a fractured part. The Prussian tool makers know this, and in lieu of the American cast-iron wheels and levers supply cast or forged steel for these parts.

Complaint is also made that not enough attention is paid to bearings; that very often not only the cheapest grade of white metal is used, and that these bearings run out very quickly. Attention is called to the fact that shafts are sometimes found running direct on the cast iron of loose pulleys of counter shafts without being lined with brass. When these bearings run out it is not only difficult but costly to bore them for brass bearings. [illegible] main spindles often are not ground and [illegible] and that insufficient attention has been paid to [illegible]

Apparently, some of the foregoing [illegible] our manufacturers as well taken, for [illegible] to one Worcester house and one Cincinnati firm, both manufacturers of engine lathes, where tools are being [illegible] for the German trade with the errors described largely corrected. It is the consensus of opinion that there should be less use of cast iron especially in tool holders, cams, and levers, and if steel is not used wrought iron should be utilized.

IMPORTANCE OF GOOD ASSEMBLING.

The agents complain the most about the assembling work, and declare that many tools are sent to Germany which appear to have been thrown together in the home shops; the result is that these tools, which have not been well put together, have to be made good, and what in the home works would have cost but a few dollars for a careful control, costs at least ten times more when done on the road. Naturally, such criticism falls on the inspector in the home shop, and there seems to be an impression here that good work is neglected in order to increase the output of machinery. The fact is not understood abroad that in the rush of business of the past three or four years in America many buyers at home would have been very glad to have received almost anything in the shape of a machine, and where shops were working overtime the assembling work may not always have received the nicety of attention which a scrupulous buyer would demand. Unfortunate as may have been some of the mistakes made in this respect, the complaints are really only murmurs, when one considers the almost universal praise accorded the high standard of workmanship on American tools.

The writer is convinced that for the most part the criticisms leveled against some of the American machine tools are either trivial in character or the importance has been exaggerated, but the criticism is made that the quality of some of our makes in the past three years has been inferior to the standard of former years. This question can be definitely answered by each manufacturer for himself; but I find this criticism coming from friends of the American machine tools who are inclined to be charitable, and ascribe it to the rush times in America of the past four years. Speaking generally, however, the European does not appreciate the American notion of getting all possible work out of a tool in a few years, then scrap heap it, and buy a better one.

DURABILITY, FINISH AND WEIGHT.

The Germans are apt to look at a machine and mentally determine its length of life. They are critical, and not only want machines well finished, but very durable in design. The opinion prevails that American machines do not last more than eight or ten years, i. e., the vital parts give way in about that period. Nowithstanding all of the foregoing, the German admits that the American machine tools, with certain exceptions, perform better work than the continental machine tools in the same class. As an illustration: A German manufacturer of machine tools, when recently building a new shop, equipped it throughout with American machine tools. He did not even draw on his own makes. These latter statements are facts

which are not generally known in the trade. Despite the small complaints, which in some cases are no doubt justified, it can be asserted that the best grades of American machine tools are to-day in advance of European makes. This lead can only be maintained by bearing down hard on technical features; not so much ingenious devices as good labor-saving and other substantial qualities.

There is a diversity of opinion regarding the advisability of increasing the weight of American machine tools. Two of the largest importing houses in Germany are diametrically opposed in their opinions on this point. The head of one firm declares that the machines are not heavy enough, the second firm declares that they are of sufficient weight. The latter firm does the larger business.

CUSTOMS DUTIES AND PRICES.

The present duty on imported tools is inconsequential; it is not over 6 or 8 per cent. The sentiment prevails in certain German quarters that this duty should be raised. When that occurs it will be for the manufacturer to say whether he will reduce his prices, and by the manufacturer is meant the American manufacturer. The opinion prevails in the best-posted quarters in Germany that there is no occasion to cut prices at present. The continental buyers are now accustomed to have American machine tools quoted at stated figures. Machines, other than American, are often bargained in. This situation is noteworthy, and should be well considered. During the spring of 1908 a number of American exporters directed inquiries as to the advisability of lowering prices, due to the general depression in business. Well-informed observers declared, however, that this would be a mistake. The market is at present quiet in Europe, and it is doubtful if any stimulation will be occasioned by over anxiety on the part of American manufacturers to sell goods. When the market revives the demand will come, and with it a demand for high-grade machines, and always, with the exception as indicated in previous reports, the tools for high-grade work must be obtained in America. It does not always happen that a business depression occurs in Europe simultaneously with a similar condition in America, and during the spring of 1908, while conditions generally were very quiet in Europe, there were sections and districts here and there which were running full-handed.

FOREIGN TRADE.

The foreign trade may not be essential to many of our machine-tool firms during good times at home, but it is certainly an excellent balance wheel in poor times, when orders are not coming in from the home market. That firm is fortunate which, during such a period as

the present, has sufficient foreign orders in hand to hold together its organization, and when good times do return the foreign business which so many of our firms are now strenuously endeavoring to secure should be jealously guarded and considered as a valuable asset. But before a foreign trade can be developed the manufacturer must have a knowledge of conditions as they exist abroad. This must be something more than a superficial knowledge, and it is on this point that so many of our firms are weak. American machine tools can not be sold in Europe through the medium of correspondence, and yet the attention of the writer has been called in many instances to new machine-tool houses in America endeavoring to sell goods in Germany by writing letters in English descriptive of their machines. The conditions are widely different from those which obtain in America, and it may be confidently asserted that any machine-tool house which hopes to successfully introduce its tools on the Continent must, through a personal representative, study and learn the ground from observation. The only offset to this is to turn the representation over to a continental firm. There are advantages in the latter, and there are also positive disadvantages. If an American house can establish a reputation for its machines, business opportunities will be found to exist abroad as elsewhere. But Americans must be exported with our machines, and the foreign field entered seriously, and not used as a market of convenience when times at home are dull. If a new firm proposes entering the European field it will be the part of wisdom to send a member of the firm abroad who will devote several weeks entirely to the business and personal investigation. Once it is determined to enter the European field, every care should be taken to send forward only the best machines. It must be borne in mind that shipments to Europe involve long intervals between the receipt of communications, and misunderstandings which may arise can not be adjusted within a few days' time.

The best American machine tools, and all new and special tools possessing merit other than mere ingenuity, will always find a market in Europe.

REPORTS ON SPECIAL LINES OF MANUFACTURE.

GAS ENGINES AND FUEL.

While in Cologne my interest was attracted to experiments being made in gas engines for marine purposes, and on March 6 the Gasmotoren-Fabrik Deutz, located near Cologne, was visited, which at that time was engaged in building a Rhine tugboat with a suction gas plant of 500 horsepower. This tugboat, the builders said, would be running in a few months' time. The fuel will be lignite briquettes.

The fuel used for marine gas engines has in all cases been German *anthracite coal.* This statement refers to marine gas engines built

by the Gasmotoren-Fabrik Deutz, and so far as known the statement applies generally to all marine gas-engine work in Germany. Up to the present time the Gasmotoren-Fabrik Deutz, which may be regarded as the leading gas-engine plant in Germany, has only equipped boats for river traffic with suction gas engines.

EXPERIMENTS WITH BITUMINOUS COAL.

Gas engineers have been struggling for some time with the problem of how to successfully use bituminous coal in connection with gas engines. Anthracite coal presents less difficulty than does bituminous, and while there are many land installations of pressure producers working with bituminous coal, the opinion is held by many, and notably by Mr. J. E. Thorneycroft, who is taking a lead in England on these subjects, that the system is too cumbrous for marine work. Mr. Thorneycroft declares that in many cases the marine producer, to deal with bituminous coal, must be designed on different lines than the present land device. The marine producer, he says, must be arranged to consume the tar which is evaporated from the coal in the first stages of its heating. In some producers the gas is taken off at a comparatively hot part of the fire instead of near the top of the new coal, which latter is the general practice with anthracite producers.

PURIFYING THE GAS.

On the other hand there are bituminous plants now at work, it is said, which are fed by an undertype stoker, so that the new coal is forced into the hottest part of the fire, and the tar, which is driven out, is at once burned. The gas must be cooled after it leaves the producer, and it must be thoroughly cleaned. There is always a certain amount of impurity in the gas, even when anthracite coal is used. According to present-day practice in Europe the cleaning is generally effected by passing the gas through a series of scrubbers, where the gas has to pass through layers of coke over which water pours. In some cases the gas is cooled by passing it over a water reservoir, which in turn acts as a generator for the steam required by the producer. There is some disadvantage in this method, it is declared, when the producer is not working at a uniform load, as the steam will not be generated until the producer has been working some time, and will continue when the engine has been stopped and when not required, and so cool the fire, causing the gas to be poor when the engine has started after this temporary stoppage has taken place.

In the German Capitaine system of gas engine for marine use the large space occupied by the ordinary coke scrubbers, and which pro-

hibits their use for marine work, is obviated by an arrangement which permits of the introduction of a very fine spray of water, which mixes with the small particles of dust and other impurities in the gas, and forms a sort of fog. The gas in this fog stage is passed into a centrifugal apparatus having a peripheral speed of 160 feet a second, which throws out the moisture and impurity, leaving a clean, dry gas to be drawn out by the engine.

Mr. Thorneycroft states that the size of the producer for a given power is comparatively small, when it is known that the area of the fire grate necessary is only 0.05 square foot per horsepower, whereas the average for an ordinary natural-draft steam boiler, burning 15 pounds of coal per square foot of grate area would be 0.2 square foot per horsepower. The depth of the fire, he says, will vary considerably with different qualities of coal used, but will not be more than two to three times the diameter of the fire grate.

TYPES OF PRODUCERS AND EXPERIMENTS.

Among the principal types of producers now in service in Europe are those of Messrs. Dowson for anthracite coal; Duff-Whitfield, arranged for working with bituminous fuel; Boutillier, arranged for working with bituminous fuel; the "Jan," consisting of a series of producers which are arranged to work in sequence; and the Capitaine system previously referred to.

In a previous report, dated Berlin, February 27, reference was made to experiments now in progress on the part of Messrs. Beardmore with a marine gas engine of large power. The firm has completed an engine of the marine gas type of between 500 and 600 horsepower, but the engine under construction is of still larger power. The opinion of well-posted German engineers was given in the report alluded to, that gas engines will yet be doing service aboard ship, but there is a tendency to believe that the pressure gas producer, and not the suction system, will be the one eventually adopted for marine work. This refers to sea work and not to river or harbor traffic, where coal piles are convenient at hand.

THE CAPITAINE GAS-ENGINE SYSTEM.

Emil Capitaine, who died recently, was regarded as one of the foremost engineers in Germany in the development of a "gas producer" for ship use. Messrs. Thorneycroft some time ago secured the English rights for his design, and at the same time Messrs. Beardmore, of Scotland, have completed an engine of the marine type of between 500 and 600 horsepower, and have another engine under construction of larger power. I understand this latter engine will approximate 2,000 horsepower, but on this point can not speak advisedly. Messrs.

Beardmore inform me that they are at present experimenting with the completed engine, but find that there are many points requiring careful consideration before they can declare themselves ready to put their work on the market, points that have more to do with producers than engines. It should not be long, however, before the Beardmore' experiences are available, when some interesting data may be expected. The Capitaine system is already in service to a considerable extent in Europe, and where employed the suction gas plant is utilized. This service, it must be understood, is with small craft.

In the suction gas system the gas, instead of being generated by the combustion of fuel by air and steam being forced through it under pressure, is generated by the air being drawn through the producer, the whole of the apparatus working somewhat below atmospheric pressure. The advantage claimed for this system is that neither the steam boiler working under pressure, nor a gas container for holding the gas is required; and the further very important advantage for marine work is that there is no danger from leakage of gas from the producer. If leakage takes place, it is from the atmosphere into the producer itself.

Already the designers are encountering obstacles in the utilization of the gas producer for marine purposes, owing to inability to use bituminous coal. It is conceded that it is too difficult to make a satisfactory small plant work with bituminous coal. It is claimed, however, that for larger powers and for vessels that have to take up fuel at different ports the producer must be capable of dealing with coal other than anthracite, which may be of a tarry or caking character. Engineers who are well informed on this subject declare that the gas engine will yet be doing service aboard ship. There is a variance of opinion as to the practicability of the gas engine in powers above 1,000 horsepower, and there are good German engineers who assert that the gas producer for marine purposes must be a pressure gas producer and not one of the suction system.

AMERICAN STEAM PUMPS.

American steam pumps are holding their own among some of the best German shops. This is all the more noteworthy, by reason of the fact that first-class steam pumps are built in Europe. Weir Brothers, of Scotland, make a first-class pump and have practically the best of the British Admiralty business. However, it was with no little satisfaction that I noticed March 13 in Station No. 3 of the Leipzig Electric Centrale three steam pumps from the American Steam Pump Company, Battle Creek, Mich., and three of the marine type combination steam engine and pump of the Worthington-Blake make. The Battle Creek pumps were sizes 203 by 1.27 by 305 milli-

meters, and Worthington-Blake steam engines were superimposed on the pumps. These pumps were built, I am informed, near Berlin by arrangement with the American parent company. The German navy authorities, it is understood, require that all important fittings for their ships, including pumps, be manufactured in Germany.

No. 3 station is the very latest constructed power plant in the Leipzig Electric Centrale system; in fact the installation work, so far as concerns the cleaning up around the buildings, is not yet fully completed. Apparently no efforts have been spared to obtain the latest and most up-to-date equipment. I found in place three beautiful engines—compound-vertical—all directly connected to Allgemeine E. G. generators. These engines were built by Ph. Swiderski, of Leipzig, and are of 600 nominal horsepower each. Seldom are engines seen more beautifully finished than these three, and it was apparent that the builder intended that the machines should not only work but serve for exhibition purposes. But what was especially interesting was the presence of Lentz valve gear on all three machines, reference to which was made in previous reports from Berlin and Dusseldorf.

No. 3 station is provided with four Steinmuller water-tube boilers, and I found that the usual German brown coal is being used as fuel. The stoking is all automatic, the chutes in this instance coming from Unruh & Liebig, of Leipzig. I understand that the above engines are run ordinarily at about 12 atmospheres pressure, using superheated steam of 300° C. In his talk with me, the machine master of the station spoke in high terms of the working of the various American pumps under his control.

THE CUTLERY INDUSTRY AT SOLINGEN.

While in the Rhine district Solingen was visited. This is the center of the cutlery industry in the German Empire. There are firms in Solingen who, it is asserted, do not sell a pound of product in Germany. Every item produced is for American orders. For the most part the goods are for large department stores in the United States, and comprise scissors, knives, manicure sets, and the like, which goods find ready purchase in America despite the tariff.

Solingen is a characteristic German country town, picturesquely situated in the Rhine country. The nearest large cities are Dusseldorf and Cologne. A great deal of the work is sent to the homes of the people, and is handled by women as well as men. At nearly all the Solingen workshops one can observe the country folk coming and going, bringing in finished work and taking home bundles of rough-finished scissors and other cutlery parts. Near Solingen, on the banks of the river Wupper, workmen's homes are scattered for many miles up and down the stream. The great majority of these houses

are fitted up with grinding machines operated by the current of the river, and here in his home the workman grinds and polishes scissors and knives for the Solingen shops.

REASON FOR LOW COST OF PRODUCTION.

The tendency at present is to concentrate the workmen more in the town shops, but this, I believe, is more a matter of state neccessity than of preference on the part of the manufacturers. It would seem that one reason for the low cost of production is the fact that under

FIG. 8.—Dwelling, and water wheel for grinding.

the present system it is not necessary to maintain extensive works. About all that is necessary is a receiving and serving-out department, assembling room, and offices for accountants. Some of the Solingen firms have their offices in what to an American look like small, old, and dilapidated buildings, and the impression is gained that there is not much expense in the matter of workshops. One of the most important workmen in a Solingen factory appears to be the grinder. A grinder's wages are exceptionally good. Practically all work at Solingen is piecework. For this reason it is difficult to make any definite statement regarding wages, but one manufacturer informs me that 3 marks a day are looked upon as wages in general for the Solingen district.

AMERICAN RAZORS AND SAWS.

I have seldom found a district where American events are so closely watched. There is a natural reticence here regarding business methods, and the impression is given that Solingen does not wish much inquiry from the outside. The advent of a new American safety razor, for example, has produced some alarm as indicating what American manufacturers are able to do. I asked one Solingen manufacturer to indicate just why it is possible for Solingen firms to sell cutlery in American despite the prevailing duty, and he replied, in effect, that it is because the methods at present pursued in Solingen

FIG. 9.—Interior of a Solingen cutlery workshop.

make it possible to get the material out at a very cheap rate, and, furthermore, long experience has taught the Solingen workmen facility in working up the present grade of metal.

I found in Solingen a firm which in previous years has enjoyed a most enviable reputation for its high standard of saws, and yet I was informed at this establishment that its German business had been practically ruined by an American saw made at Philadelphia. In fact the statement was made that the business of the Solingen firm is restricted to those districts which have not been reached by the American saw representatives. My information is to the effect that the American saw is bringing a higher price than the German saw, and that its success here is due to its superior quality. Here is a curious

situation—German cutlery firms sending their entire output to America despite our tariff, and a Solingen saw house being practically forced out of business by the advent of a high-grade, higher-priced saw made at Philadelphia.

A REVOLVING HAMMER.

The Deutsche-Niles-Werkzeugmaschinenfabrik, located in Ober Schöneweide, near Berlin, have installed a revolving hammer, the design of Engineer Carl Huber. There are two working arms of the machine, and as the blow is delivered against the anvil the striking head recoils, clears the anvil, and continues to circle until again ready

FIG. 10.—A Solingen grinder.

to strike. The machine is operated by a belt, and the design is such that two hammers can work at once, one delivering blows from above and a second from below. There is no question about the speed of the machine; indeed, I may say the main difficulty has been to reduce the rapidity so as to approximate in effect to the long, heavy sledge-hammer delivery of hand use. Where two hammers are used no anvil is necessary, and here the machine is seen at its best, for, as is well known, the anvil absorbs power; in other words, the entire energy is converted into forging work.

The two rotating systems act better when made to coact by being connected by toothed gear in order to insure that the blows from

either side are simultaneous. This affords uniform forging. It will be gathered from the foregoing that the utilization of power usually absorbed by the anvil is of great importance, and especially so when considering economical operations.

THE HAMMER AT WORK.

In the hammer at work at the Deutsche-Niles works there are only two striking arms, but I understand that the design permits of four being employed. Generally speaking two hammers suffice, and for every revolution each hammer strikes twice. The machine may be directly coupled to a belt, electromotor, or steam turbine. There is a spring attachment connected to each hammer. When not working the springs cause both hammer elements to impinge in the circumference of the housing, but as soon as the machine is started the arms, by reason of the centrifugal force employed, are released, the action being akin to the movements of the balls of a governor. This equal outward swing of the hammers would, of course, not give the desired result. Therefore, as soon as the hammers have made a number of revolutions, the anvil would have to be put into position in order that the hammers could do their work. As soon as one of the hammers loses its even small amount of energy at its first blow on the anvil the other hammer takes up a position on the outer active course and compels the first to return to the inner inactive course. Thus the necessary impetus is given, and an outer and inner course on the upper and lower sides of the housing is formed in order to guide the active hammer, immediately after having expended its energy, out of the outer course into the inner inactive course past the work or anvil and to allow it to pass again into the outer course at the right moment.

The space taken up by the machine is trifling. It does its work well and cheaply, and the design throughout shows high engineering skill.

THE WORKS OF FRIED. KRUPP, A. G., AT ESSEN A. R.

THE LARGEST EUROPEAN MANUFACTURING CONCERN.

The writer has visited while in Europe many hundred manufacturing establishments. Many were large and many small, but by far the greatest of all was Krupp's. Over 65,000 men are carried on the pay rolls of the combined works at Essen, Magdeburg, Kiel, and the plants on the Rhine, and this means that more than 180,000 souls—men, women, and children—are dependent on Krupp. In the ninety years that the Krupp works have existed such a thing as a strike has never been known. Ask the secret of this, and the answer is found in the eminent tact, skill, and wisdom displayed by the directors.

Of the three Krupps, Fried. Alfred, the son of the first Krupp, may be said to be the founder of the present works. It was the second Krupp who discovered a method for making steel tires for railway wheels, and it was this invention, and not guns, which proved the first gold mine for the establishment. It is true that much of the publicity attached to the Krupp works has come from the manufacture of heavy ordnance, but the general impression that Krupp makes only guns is erroneous.

HISTORY OF THE WORKS.

Fried. Krupp, the original founder, started the manufacture of crucible steel as far back as 1811. In 1826 he died. His son, Alfred Krupp, was then only 14 years of age, but when he grew to manhood he naturally succeeded to his father's position, and in 1843 he brought out the first application of cast steel to small-arm barrels. In 1847 the first gun was finished, of cast steel, a 3-pounder. The manufacture of weldless-steel tires from Krupp's patent was commenced in 1853, and in 1854 a 12-pound gun of cast steel was built. In 1862 Krupp brought out his flat wedge breach mechanism. In 1864 the erection of rail and plate mills was commenced, and in 1865 Krupp changed his flat wedge breach mechanism to the round-wedge system. In 1867 he was able to exhibit at the Paris Exposition a 1,000-pounder.

Alfred Krupp continued in active charge of the works until 1887, when he was succeeded by his son, Friedrich Alfred, who remained at the head until his death in 1902. The second Krupp was essentially an engineer, hard working and aggressive. But he also found time to do something for the welfare of his men. He built many homes, now known as the old Krupp houses, which were made available for the workmen at nominal rental and, engineer-like, he laid these houses out with mathematical exactness in every line. There were the same number of windows in each dwelling, and the trees were planted at exactly the same distance apart.

The last Krupp, when compared with his father, might be termed more of a philanthropist of artistic inclinations. He was never an eminent engineer. To understand better the difference between father and son, one has only to go through the Essen works, and despite the vast extensions of the past fifteen years, the shop management shows practically the same stamp the old master imprinted.

From originally starting as a mere blacksmith's shop at Essen, the Krupp works now control important industries in a number of other cities. One of the most recent acquisitions is the Germania shipyard at Kiel, where Krupp is enabled to construct war ships, and, through the medium of subsidiary plants, is almost completely independent of outside help.

KRUPP EMPLOYEES—NEW BUILDINGS.

Of the total 65,000 men on the Krupp pay rolls, the Essen works absorb about 35,000. From a recent table issued by Krupp, the assignment of employees is as follows:

Essen works	35,135
The proving grounds	610
Collieries	9,302
Iron-ore mines	4,638
Iron works on the middle Rhine	1,116
Friedrich-Alfred-Hütte	4,384
Annen Steel Works	891
Grusonwerk at Magdeburg-Buckau	4,768
Germaniawerft at Kiel-Garden	3,510

By recent census it was shown that the number of workmen and their wives and children dependent upon the works amounted to more than 182,000.

Around the ancestral home the Essen works have expanded in all directions. Five years ago the writer was afforded an opportunity to see much of the establishment. Upon visiting the works on March 23, 1908, I found that several large new shops had been erected and that a number of old buildings had been, or are being, torn down to give way to new structures. A new office building was about to be built, the ground for which had already been broken. On the whole there is apparent a little more touch of progress than was evident a few years back. But the visitor will probably be disappointed if he expects to find the new shops full of new tools. The Krupp factory seems inclined to hold on to a machine as long as it will do service. To be sure, the bulk of the work at Essen is of heavy duty character, requiring ponderous machines. Ernst Schiess, of Düsseldorf, has furnished most of the heavy tools, although Grafenstaden has also been drawn on. In one of the new shops work was in progress on material for the German navy, and my attention was called to shafting for some of the new battle ships of the British navy, as well as for high-powered destroyers.

CRUCIBLE NICKEL STEEL.

Essen is essentially notable for its crucible nickel steel. There is so-called crucible nickel steel made elsewhere in the world, but, so far as known, the Krupp material is unexcelled. This accounts for the large exportation of Krupp crucible nickel steel to the United States. In the case of engine parts, where heavy strains are exerted, manufacturers feel the necessity of acquiring the best steel obtainable. regardless of origin. The process of making crucible nickel steel at the Krupp works is jealously guarded, although, as one official remarked, even if all the details were known the steel could not be

made in America or elsewhere, since only the Krupp works possess both the requisite organization and experience. This crucible nickel steel is almost exclusively used by Krupp for gun work, and accounts in a large measure for the high reputation of Krupp ordnance. For a given caliber Krupp can be expected to produce a lighter gun and one capable of withstanding greater pressure, which means a greater muzzle velocity and striking energy. This fact was demonstrated when Krupp some few years ago produced a field gun after American specifications which afforded a greater effective shrapnel range on less gun weight than the type American gun.

In general, when one speaks of Essen, it becomes necessary to refer specifically to particular shops. The armor-plate shop, for example, is very modern, and is really the most complete of all the Krupp departments.

VARIOUS KINDS OF STEEL PRODUCED.

There is no question as to the vastness of the Krupp gun shops, but to an American, accustomed to see the most modern machines in use, there is suggested a need of later-date tools. The writer has in mind many American-made machine tools which could do good service at the Krupp works, and there is a natural suggestion that this great plant has been neglected by the representatives of some of the leading American firms. The various kinds of steel manufactured at the Essen works comprise crucible steel, Martin (open-hearth) steel, puddled steel, Bessemer steel, and hard steel. Besides the grades mentioned, alloys of steel, with tungsten, nickel, chromium, molybdenum, are produced for particular purposes. Crucible steel, as above-mentioned, is mainly used for guns. It is also employed for armor-piercing shells, and for the important structural parts of locomotives, engines, and hoisting machinery, armor-plate rolls and mint rolls, and for other rolls in which a minimum of wear and tear is desirable, and which at the same time demand the greatest possible safety against breakage. In this last-mentioned class are tires and axles, and tool and spring steel.

Martin (open-hearth) steel is used for the various requirements of shipbuilding, such as plates and angles, for armor plate, for projectiles other than armor piercing, gun-carriage parts, boiler plates, and the like.

Steel castings from both crucible and Martin steel are produced for numerous purposes, the chief product being frogs and crossings for railroads, wheels for locomotives and cars, certain shipbuilding elements, such as stems and sternposts, rudders and propellers, and castings for building structures.

Puddled steel, while mainly used at the works as raw material for crucible steel, is also furnished the market for the manufacture of

spoke-wheel centers and welded disk wheels. I understand there is great demand for this puddled steel abroad, where it is sold under the name of Milano and bamboo steel.

The Bessemer steel is worked up into rails, and also enters the market in the shape of bars for the manufacture of tools, springs, wires, and plates.

The nickel crucible steel is of a special and approved composition, and combines the good qualities of soft, fibrous, wrought iron, with the high tensile strength of the best kind of steel. The crucibles used by Krupp are made in a special department of the Krupp works.

Krupp is also turning out some special grades of steel for motor cars, possessing extraordinarily high tensile strength, with elasticity and tenacity. Hard steel is so tenacious an alloy that it does not allow of machining, and is applied in the manufacture of crushing machinery, dredges, trailing wheels, mandrils, and safes. In addition to the various kinds of steel mentioned, Krupp produces cast iron, wrought iron, and bronze for special purposes, the latter chiefly for propeller blades and shaft jackets.

WAR AND OTHER MATERIALS.

The Krupp outputs may be divided under two heads, viz, (1) War material; (2) products of general industry.

Under the head of war material come guns, turrets, armor shields, all kinds of gun carriages, hoisting and transporting machinery for ammunition and ordnance, ordnance wagons of all kinds, harnessess, observation appliances, ammunition, rifle barrels, and armor. Krupp supplies field batteries complete, even to saddles and harness, leaving only men and horses to be supplied by the governments. In this connection it should be known that Krupp confines his sale of war material to governments. In the United States Krupp is represented by Thomas Prosser & Sons for products for general industry, and by Maj. A. E. Piorkowski for war material.

Under products for general industry Krupp produces railway material, including wheels, tires, axles, springs, boiler plates, frame plates, press car frames, structural parts of locomotives, rails, switches, frogs, portable railroad plants, together with requisite rolling stock; shipbuilding material, machinery parts, sheet steel and sheet iron, rolls, tool steel, steel for motor-car building, hard steel for stone breakers, dredges, etc., and steel bars of special qualities.

GAS AND COAL CONSUMED.

There is more gas used in lighting the Essen shops than is used by the entire city of Bremen. In the 60 odd departments there are *more than 6,500* machine tools in use. There are 155 steam ham-

mers, 21 transmission hammers, 74 hydraulic presses, 2 presses measuring 7,000 tons each (bending), 1 of 5,000 and 1 of 2,000 tons, respectively, for forging purposes. There are over 300 stationary steam boilers, more than 70 locomotive steam boilers, about 540 steam engines, aggregating nearly 60,000 horsepower, and considerably more than 700 cranes. During the year 1906 the combined Krupp works consumed 1,285,310 tons of coal, of which quantity the Essen works used 813,155 tons. In addition there was used coke and briquettes, which make, substituting for coal and briquettes their equivalents in coal, a total of 2,361,425 tons. The total yearly consumption of water nearly equals that of the city of Cologne, and the gas consumed exceeds the consumption in Munich, and also in Nuremberg.

CONDITIONS SURROUNDING EMPLOYEES.

The efforts of the second Krupp (Alfred Frederick Krupp) to better the welfare of his employees was pioneer work in Germany, but it was without beauty or form. It was left to the son (the last Krupp) with his sense of the artistic to build up beautiful colonies and villas on the outskirts of Essen, with their pretty flower gardens, handsome squares, and well-kept streets and walks.

The workmen's colonies lying within the compass of the Essen Steel Works are known as Westend, Nordhof, Baumhof, Schederhof, Cronenberg, Alfredshof, and Altenhof. The last named is for aged, disabled, and pensioned workmen, and comprises a total of 4,691 lodgings, inclusive of a number of scattered houses in Essen owned by the firm. Outside of Essen there are workmen's colonies for the detached works, such as Gaarden for the Germaniawerft, and Annen for the Annen Steel Works, as well as others.

On January 1, 1907, the total number of family dwellings owned by the firm of Fried. Krupp was about 7,000. For unmarried workmen there are at the Essen Cast Steel Works two workmen's barracks, affording lodging for 1,170 and board for about 3,000 persons daily; two lodging houses for 30 skilled workmen each; at the Rheinhausen works three dormitories, aggregating 550 beds, and dormitories at various other branch works of the firm.

The total number of unmarried workmen housed on January 1, 1907, in Krupp's lodging houses, barracks, and dormitories amounted to about 2,300. According to a census taken in May, 1905, there were 9,614 employees of the firm living in houses belonging to the Essen Works. The members of the families of these employees totaled 21,530, or making a total of 31,144 persons living in houses of the works in Essen.

The supply stores of the Essen Steel Works embrace 77 shops (of which 49 are in Essen) for the sale of meat, bread, colonial produce, manufactured goods, haberdashery, shoes, ironmongery, and house-

hold furniture; 25 shops for the sale of potatoes, coal, straw, etc.; further, 2 slaughterhouses, 1 steam bakery, 1 bakery (hand worked), 1 flour mill, 1 ice-making establishment, 1 brush factory, 1 paper-bag factory, 1 coffee roasting establishment, 2 tailors' workshops, 1 shoemaker's workshop, 1 laundry, 1 hotel, 2 clubhouses for officials, 1 clubroom for foremen, 11 restaurants, 9 shops for the sale of beer, and 3 coffeehouses. The number of persons employed at the supply stores, on January 1, 1907, was 1,169. Besides the supply stores at Essen, special stores have been established for the Grusonwerk at Madgeburg, and the Germaniawerft at Kiel.

FUNDS AND ENDOWMENTS.

Apart from the funds prescribed by law, a number of aid funds and similar benevolent institutions have been provided by the Krupp firm.

These are: (1) Workmen's Pensions Funds, the one at the Essen, with a capital of 17,250,000 marks, and the other at the Friedrich-Alfred-Hutte, with a capital of 377,700 marks. Both funds also grant pensions to the survivors. (2) Officials' Pensions Funds, comprising, for the Essen Works and outlying plants, a capital of 7,800,000 marks, and for the Grusonwerk, a capital of 2,200,000 marks. (3) Workmen's Aid Fund of the Grusonwerk, with a capital of 365,000 marks. This fund grants a regular stipend to aged or disabled workmen and to their widows.

In addition to the above the late Friedrich Alfred Krupp founded and endowed the following institutions: (1) The Workmen's Fund and the Aged and Disabled Workmen's Fund, supplementing the aid rendered by the various other funds, with a joint capital of 5,700,000 marks. (2) The Kaiserin Augusta Viktoria Fund, intended to facilitate the reception of workmen into the Krupp Convalescents' Home, founded with a capital of 300,000 marks. (3) The F. A. Krupp Fund, intended to facilitate members of workmen's families, being received into the Krupp hospital, with a capital of 40,000 marks. (4) The Gruson Workmen's Fund, with a capital of 150,000 marks. (5) The Gruson Workmen's Bonus Fund, with a capital of 100,000 marks.

Under the workingmen's insurance act the Krupp firm (inclusive of the outlying works) in 1905 paid for insurance against sickness 1,184,870 marks; for accident insurance, 1,422,922 marks; and for insurance of the aged and disabled workmen 463,298 marks, or a total under the act of 3,071,091 marks.

The statutory contributions of the firm to funds not prescribed by law in the same year were to various funds 12,959 marks; to the workmen's pensions funds, 1,171,292 marks; and to the officials' pensions funds, 253,685 marks; or a total of 1,437,937 marks.

The grants in accordance to the various endowments and funds of the firm, together with other aids and allowances by the firm in 1905, as well as the sums spent for the promotion of the general welfare of the employees, amounted to a total of 2,372,824 marks. The aggregate of the contributions paid by the firm in 1905 to insurances and funds amounted to 6,881,853 marks.

BENEVOLENT FEATURES.

In addition to the foregoing are the following benevolent institutions:

At the Essen Steel Works, 1 hospital, 2 barracks hospitals in case of epidemics, 1 convalescents' home, 3 houses for the aged and infirm in the Colony Altenhof, 1 bathing establishment in the Colony Friedrichshof, 1 establishment for medicinal baths, 1 steam laundry for the hospital, 6 dining halls (including one dining hall and kitchen with steam plant at the workmen's barracks), 1 housekeeping school, 1 industrial school for adults, 3 industrial schools for school girls, 1 circulating library, 1 reading room in the Colony Friedrichshof, 1 savings bank, 1 life insurance society, 1 surgery for dentistry.

At the Friedrich-Alfred-Hutte there is 1 dining hall and kitchen with steam plant.

At the Grusonwerk, 1 canteen, 1 officials' clubhouse, 1 workmen's kitchen with 3 dining halls for 1,000 persons, 1 convalescents' home at Hasserode in the Harz Mountains, 1 savings bank, 1 circulating library.

Finally, there are several dining halls, kitchens, bathing arrangements, etc., at the Germaniawerft, Annen, the iron works, and other outlying works of the firm.

But aside from all that the Krupp firm does for its workmen, the very essence and life of the establishment is its discipline. It is doubtful if there is a more prosperous or contented body of workmen in the world than the men at Essen, and the one striking feature which stands out distinct and clear is their loyalty and devotion to the Krupp firm. The Socialists have never been able to make any entry into that great Krupp district.

The entire social system at Krupp's has worked out satisfactorily.

The Germans are firm believers in the three K's for women, so patly phrased by their Emperor, Küche, Kinder, Kirche (kitchen, children, church), and Krupp has never failed to maintain cooking schools at Essen. So proficient do the young women become that one hears it laughingly said that a Krupp man never thinks of marrying any but a Krupp girl. In everything pertaining to the welfare of the workmen the Krupp directors are concerned. Hospitals are numerous and every attention is paid to the sick and injured.

LOCOMOTIVE CONSTRUCTION.

MACHINE TOOLS USED—ECONOMICAL FEATURES OF NEW TYPE ENGINES.

Acting under special orders, I made inquiries while in Germany regarding locomotive development, especially with reference to tools employed and standards in force. Operations in the Swiss and Italian shops will be found under the Swiss and Italian works. The German notes have been collected under one head.

The development in German locomotive construction during the past five years has tended both toward higher speeds and greater economy. This refers more particularly to the locomotives required for fast passenger service. The exigencies of traffic, not only in Prussia but on the Continent generally, are from year to year demanding more powerful types of locomotives and accompanying higher steam pressures, and in this connection superheated steam seems to be the vogue. On the Prussian state railways, however, the exception is noted in the case of locomotives fitted with superheaters, where a pressure of 170 pounds has been retained as maximum.

The principal railway lines of the southern German states and of Austria, Switzerland, and France may be referred to as the principal adherents of the 4-cylinder compound engines, and some of these lines have been experimenting with this system in combination with superheaters.

The opinion of some of the best locomotive engineers in Prussia is that balanced compounds run very smoothly. The same engineers point out that as the force acting on the piston is relatively small, it is practicable to construct a more robust engine framing. The result obtained is a positive advantage. In Belgium, on the other hand, the preference in the early part of 1908 seemed to be for the 4-cylinder noncompound engines with superheater. This is particularly true in the case of the express locomotive service. For freight engines the Belgians seem to prefer the 2-cylinder noncompound engines with superheater. So far as can be ascertained the 3-cylinder compound engine has not been tried to any great extent on the Continent of Europe. I learn that the Jura-Simplon Railway, which is now the Swiss-Federal Railway, has several mogul engines of the 3-cylinder compound type at work, and the reports are that the Swiss are very well satisfied with these engines. They have also mogul engines of the 4-cylinder compound type. The Northwest-of-Austria Railway has also, it is said, built an experimental engine of this latter class, and I learn that the same statement applies to the Northeastern and Midland Railways of England. I am advised that the special 3-cylinder compound type engine which was in use on the London and Northwestern Railway for a number of years has now entirely disappeared. From the best information obtainable superheaters have *not yet been applied* to Mallet locomotives.

FINISH AND FORM.

On the subject of finish and form, the German locomotive builders are a unit in saying that there has been little change in this direction during the last few years. It is expensive, but the trade seems to demand a very high grade of finish. In a former report reference was made to the finish demanded on the French locomotives which are now in progress of construction at the Borsig shops. Much of this work is regarded as superfluous. Many of the parts are required to be casehardened, and the designs call for slide valves of a particular kind of bronze. The standard metal, which could be supplied readily and quickly, and which the experience of years had indicated was excellent, would not suffice. Not only on the French locomotives, but on the German as well, all fire boxes and all stay bolts are made of copper. I found that the French inspectors require the bearing surfaces of the boiler saddles to be not only smooth but polished.

The European machine-tool builders have paid close attention to the requirements of European locomotive works in meeting the peculiar demands of those shops.

The success of the German locomotive is due primarily to the economical features of some of the best designs. The workmanship, as a rule, is also good. The finish and form appearing in standard German machines are largely dictated by the buyers.

During the months of February and March of 1908 German locomotive builders were enjoying fairly good business. Borsig was working at practically full capacity, and the shops of the Berliner Maschinenbau-Actien-Gesellschaft, vormals L. Schwartzkopff, were reported equally busy. In the works of the Hannoversche Maschinenbau A. G., vormals Georg Egestoff, Hanover, 3,300 men were fully engaged, and at the shops of the Hohenzollern A. G., Grafenberg-Düsseldorf, there was enough work in hand to keep 1,400 men employed. It should be borne in mind that all of the above establishments engage in other than locomotive work, but it was my observation that in the case of the Tegel, Hanover, and Düsseldorf shops there was no work in hand more important than the locomotive orders.

I am advised that the Borsig firm turned out last year about 300 locomotives, and in February the works were engaged on a number of French locomotives in addition to engines of German type. Borsig at the time of my visit was turning out about 55 per cent of their output for foreign trade, and the balance of the work was for the Prussian state railways. I understand that Borsig accepted the French contract on the basis of 1 mark 10 pfennigs (mark=23.8 cents=100 pfennigs) per kilo (kilo=2⅛ pounds). In view of this

price, the German manufacturers were at a loss to understand how an American locomotive firm could accept a French order, as was reported at the time in Berlin, on a basis of 85 pfennigs (20 cents) per kilo. The only explanation suggested to the Germans was that the Americans were delivering to the French locomotives of American design. The German builders could not understand how any money could be made on an 85 pfennigs per kilo basis, if the Americans were expected to work out French designs. I mention these views simply as a matter of interest, and as showing how trade subjects are discussed from the Berlin standpoint. Not only Borsig's, but the Berliner Maschinenbau Aktien-Gesellschaft, vormals L. Schwartzkopff, and the Henschel Works in Cassel, were recently engaged, I am informed, building French locomotives. The work required on these French locomotives is regarded by practical engineers here as entailing much superfluous finish and unnecessary detail. It will appear to an American that the cost is immensely increased; in fact, the one comment which seems to be universal regarding the French locomotives is that the French, when they prepared their designs, had plenty of money to spend. Where a standard German design would require only one slide bar, the French have managed to frame a design which entails four slide bars. I asked one German director if his firm expected to make much money on these French contracts. His reply was, "We shall at least gain considerable experience, and shall know what to expect when we take a second contract." The French locomotives are of the 4-cylinder compound type, and are intended for high-speed passenger service.

At the Borsig shops practically only plate frame construction is employed. At the Hanover works recourse has been had, in the type of locomotive for the Prussian state railways, to the American form of bar frames.

TOOLS USED AND STYLES OF FINISH.

The plate frames at the Borsig shops are cut out by oxygen gas tools, the work being effected quickly and in a most economical manner. These tools can be obtained in Berlin. At the Breslau shops hydraulic presses stamp out the plates. Efficient tools of this type can be procured from C. Huber, hydraulic press engineer, 16 Friedrichstrasse, Berlin. Special-type milling machines appear necessary to effect economically and rapidly the milling work on the locomotive plate frames, and throughout the German locomotive shops I observed that J. E. Reinecker, of Chemnitz, was drawn on largely for these millers. As one director remarked to the writer, there does not seem to be available a good American line of heavy vertical millers.

While the painting and finishing on the German locomotives is dictated largely by the buyers, there is no diminution in the German shops of those painstaking efforts which of late years have characterized the finish and form of Prussian machines. This painting, polishing of metal parts, and extra work in painting, varnishing, and rubbing down is expensive, but it has to be reckoned with. The standard has been set, and no one firm dares to reduce for fear of the comparison. Only in those cases where the buyers are willing to forego highly finished work is there any reduction in cost.

Borsig is turning out on an average 300 locomotives a year. The greatest number built by that firm in one year was approximately 350. This establishment is building for Russia, Sweden, Chile, Argentina, and the Far East. For the Argentina railways American types of locomotive are built; by that I mean in general form the engine is of American type. No engine is sent away from Borsig's before being tested and operated on the private railroad of the establishment; in other words, all the defects of the machine are discovered so far as they can be ascertained, before the engine leaves the works. The product is therefore a finished one in every sense of the word. When it is borne in mind that the fire box and stay bolts of the locomotives are made of copper, some idea can be gained of the longevity of these machines. There are some Borsig locomotives in service to-day which were constructed more than thirty years ago.

GERMAN EXPORTS OF LOCOMOTIVES.

The German export figures for locomotives for the year 1907 are as follows:

Tender-locomotives, under 10 tons, total number exported 395. In kilos weight (1 kilo=2.2 pounds) the distribution of these 395 locomotives is included in the following table:

	Kilos.		Kilos.
Belgium	97,800	German Southwest Africa	112,100
France	252,400	British India	151,400
Italy	229,300	Dutch East Indies	131,700
Russia in Europe	186,100	Argentina	202,800
Turkey in Asia	14,300	Chile	204,300
Egypt	270,300		

In reserve parts there were exported during the same period for the above engines: Italy, 30,300 kilos; German Southw[illegible] 22,100 kilos.

Locomotives without tenders, over 10 tons, total number exported 552, distribution in kilos as follows:

	Kilos.		Kilos.
Belgium	208,700	German Southwest Africa	240,900
France	345,480	China	220,400
Italy	10,424,200	Japan	225,200
Austria-Hungary	391,500	Siam	763,500
Roumania	571,100	Argentina	1,577,000
Switzerland	677,900	Brazil	1,135,200
Spain	853,100	Chile	1,761,900
Turkey in Asia	704,200		

In reserve parts there were exported in 1907 for the above engines: Italy, 48,800 kilos; Austria-Hungary, 20,300 kilos.

Germany imported during the year 1907, 5 engines from Belgium, each under 10 tons weight, and 3 engines over 10 tons weight. The latter importation was divided between Belgium and Switzerland, 31,200 kilos coming from Belgium and 19,800 kilos from Switzerland.

FIG. 11.—Row of workmen's dwellings, Hanover, Germany.

THE HANOVER LOCOMOTIVE WORKS.

The machinery works known as the Hannover'sche Maschienenbau A. G. vormals Georg Egestorff, were visited on February 26, 1908. This plant is located on the outskirts of Hanover, and at the time of *my visit the* number of employees, I was informed, was 3,300. The

plant was established in 1846, and enjoys a high reputation for the excellence of its outputs.

Expert men at the machine tools receive here, on the average, 70 pfennigs (16.6 cents) per hour, which is about 15 pfennigs (3½ cents) less than the men at Borsigs are paid. The Hanover works own about 150 houses, which are rented out on an average of 15 marks per month (1 mark=23.8 cents). The income is sufficient to keep up the repairs. No attempt is made to derive a profit. The firm is quite satisfied if it comes out even. The houses contain from four to six rooms and may be occupied by one or two families. In many

FIG. 12.—Rear view workman's dwelling.

instances one room and a kitchen suffice, but more generally two rooms and a kitchen comprise the home.

The Hanover shops have built considerably more than 5,000 locomotives, and their latest type of high-speed passenger engine is especially well spoken of. It is known as the Atlantic type, and resembles closely the American locomotive of the same class name. In this type one observes the bar-frame construction, but generally speaking the plate-frame form is adhered to. The Hanover shops apparently build as many bar-frame as they do plate-frame machines, while Borsig builds more plate-frame than bar-frame machines. Borsig, however, supplies bar frames when his customers prefer them. Borsig states that he has not found it necessary to put down special tools

for the manufacture of bar frames, which would indicate that plate frames can be made with the same tool equipment as bar frames.

The Hanover shops, however, use special types of milling machines in working up plate frames. It is the writer's observation that J. E. Reinecker, of Chemnitz, has been drawn on largely by the various German locomotive works for these millers. The Hanover works, it was stated to me, were considering the advisability of introducing the oxygen-gas system for cutting out plate frames. The policy of this firm, I understand, is to buy the very best tools obtainable, regardless of origin. At the time of my visit there were substantial orders in hand for locomotives for French railways.

BROAD AND PROGRESSIVE POLICY.

The entire policy of the Hanover shops is a broad one. The directors are keen and thoroughly progressive. No American firm should hesitate to send its representative to this establishment. A machine-tool concern that has a specially good tool to offer will receive quick recognition from this establishment, but it must be a very good tool and one possessing superior merit. The mediocre tool, or the tool which is only as good as the best German tools, can not expect to receive preference over one of local make. This is natural, and rightly so, for it must be understood that the Germans are doing all possible to foster and encourage their own industries. As a broad proposition, the American tool can find its way into German shops only when it possesses superiority.

The growth of the Hanover shops has been very gradual, and it might be said almost a struggle from the first. In 1846 the construction of locomotives was undertaken. In 1856 the one hundredth locomotive was finished. By 1870 the firm had built but 500 locomotives, but at the end of 1873 the total number turned out had reached the one-thousandth mark. Locomotive No. 2000 left the shops in 1888, and in 1897 engine No. 3000 was turned out. In 1903 the total number built was 4,000, and in 1906 the total figures had reached 4,800. The five-thousandth mark has been passed, and the year 1908 promises to be one of the best of the firm's business.

LOCOMOTIVES SENT TO MANY COUNTRIES.

This firm is not only turning out locomotives for the Prussian state railways, but is sending about 30 per cent of its output abroad.[a] To the year 1907, or to the time when locomotive No. 4800 was completed, 22 per cent of this company's output was for foreign countries.

[a] Under date of November 14 the Hanover works advise that 35 locomotives are being built for France and 15 for Chile. The number of workmen employed on this date was 4,000.

Some of these orders were from very remote parts of the world. The following list represents locomotives shipped abroad by the Hanover works:

Russia	251	France	5
Roumania	115	Sweden	4
Spain	79	Japan	93
Denmark	55	Dutch Indies	76
Turkey	54	British Indies	54
Austria	48	China	16
Portugal	40	Siam	16
Italy	40	Argentine Republic	14
Bulgaria	21	Cochin-China	5
Holland	18	Chile	4
Greece	9	Brazil	3
Norway	5		

POPPET-VALVE GEAR—VARIOUS TYPES CONTRASTED.

The Hanover shops just now are using on practically all the high-speed engines for the Prussian state railways the poppet-valve gear.

FIG. 13.—Locomotive with the Lentz poppet-valve gear.

I am assured that the saving is not less than 20 to 25 per cent, when a comparison is made between the poppet-valve gear using superheated steam and slide valves operating with saturated steam. One high-speed engine on the Prussian state railway has already run 60,000 miles, using this type of valve gear. As a further illustration of its economy, 23 engines of the International Works at Vienna had this type of gear installed on all the high-pressure cylinders, and in one year's time the entire cost of the change was saved in coal consumption alone. The Grosse Leipziger Strassenbahn not long ago converted 4 steam engines in their generating station, added super-

heaters to 5 steam boilers, and as a result of the utilization of poppet-valve gear with superheated steam saved 48,356 marks per annum, or, roughly, $12,000.

The poppet-valve gear above referred to is known in Germany as the "Lentz system." The Hanoverische Maschinenbau control the system in Germany, and so far as is known no American manufacturer has acquired the right to use the same. The Hanover shops are using the Pielock type of steam superheaters with this Lentz valve gear. The introduction of this type of poppet valve was brought about largely because of the obstacles arising when using superheated steam. The use of the flat or common slide valve had early proved absolutely unfit for highly superheated steam, and even piston valves were found to possess serious disadvantages, as they tend either to "seize" or leak. Curiously, however, the Prussian state railways are not using superheaters simultaneously with compound arrangements. This, however, is at variance with the views of the engineers at the Hanover shops.

The success of poppet-valve gear has proved so great from the economical standpoint that it is now quite common for locomotives in service to be altered and provided both with superheaters and poppet-valve gearing. The change necessitates a new cylinder as well as valve chest, since the poppet-valve box and cylinder are cast in one.

AN EARLY EXPERIMENT THAT WAS SUCCESSFUL.

One of the first engines converted at the Hanover shops was a small machine which had been turned in for repairs. A Pielock superheater of 75.3 square feet heating surface was built into the engine. As it was first intended to allow the old slide valve, used until then, to remain, the superheater chosen was comparatively small, just sufficient to produce superheated steam of from 520 to 540 degrees Fahrenheit in the dome. It was only decided after the boiler was finished to fit these locomotives with poppet-valve gear, which, in this instance, had to work with comparatively light superheating. The cylinders only were renewed, and in consideration of the use of superheated steam the diameter of the new cylinder was increased from 9⅞ inches to 10¼ inches. The tractive force now rose to 4,850 pounds, or 1/5.8 of the adhesive weight.

There are four valves in the Lentz type of valve gear, two inlet valves toward the middle, and two outlet valves toward the ends. These four valves are placed in a row, one behind the other. They are constructed as double-seat valves. The spindles are fitted with so-called labyrinth packing only. The valves weigh but 7.3 pounds and are weighted by springs. They run on rollers on a rod with lifting projections, which have four lifting curves arranged symmetrically one to another. The valves are raised by the regular to-and-

fro motion of the rod and closed again by the pressure of the springs. The whole mechanism is fitted into a metal box, which occupies a space on top of a cylinder resembling a rather deep slide-valve chest. This metal box affords a space which is dust and dirt proof. Four peep holes are let into one side for the purpose of allowing the valves to be regulated. The engineers of the Hanover shops state that even at high rates of speed, when the locomotive is making as high as 300 revolutions per minute, the distributing valve gear works quite noiselessly. The valves are guided by rollers on the rod, fitted with lifting curves. This obviates the danger of the valves striking their seats, as by this means they merely touch the latter quite gently. A photograph of one of these Prussian locomotives fitted with poppet-valve gearing accompanies this report.

SAVING IN COAL AND WATER AND REPAIRS.

One of the results of a series of trials carried on with this locomotive in comparison with former types was to show that there was a saving in water to the extent of 30.6 per cent, and a saving in coal of 19.5 per cent. Experience with this poppet-valve locomotive has shown that practically no repairs have been required.

In the Atlantic type of locomotive, as built by the Hanover shops, is found a 4-cylinder express, compound machine, which at a speed of 62½ miles an hour only makes 270 revolutions per minute. As above stated this type of locomotive is fitted with a poppet-valve gear. The Prussian state railways possess close to 200 locomotives of the Atlantic type, the principal dimensions of this type of engine being as follows:

Diameter of cylinder	14 3/16 inches–22 inches.
Stroke of piston	23⅝ inches.
Diameter of driving wheels	6 feet 6 inches.
Diameter of trailing wheels	3 feet 3⅜ inches–3 feet 7 inches.
Coupled wheel base	6 feet 10¾ inches.
Bogie wheel base	6 feet 6¾ inches.
Total wheel base	29 feet 6⅜ inches.
Working pressure	200 pounds.
Grate area	29 square feet.
Heating surface in fire box	106 square feet.
Heating surface in tubes	2,414 square feet.
Total heating surface at fire side	2,520 square feet.
Number of tubes (Serve)	138.
Diameter of tubes (outside)	2¼ inches.
Length between tube plates	14 feet 7¼ inches.
Weight, empty	56 tons 14 hundredweight.
Weight in working order	61 tons.
Adhesive weight	29 tons 18 hundredweight.
Capacity for water of tender	4,400 imperial gallons.
Capacity for fuel of tender	6 tons.
Weight of tender, empty	21 tons 7 hundredweight.
Weight of tender in working order	46 tons 19 hundredweight.

There are four cylinders for this locomotive—two high pressure and two low pressure. The present practice is to place the high-pressure cylinder outside and the low-pressure cylinder inside, as a better balancing of the engine is thereby effected. The high and low pressure cylinders of the one side form, with the valve chest belonging to the last, one single casting. The four cylinders are set across the locomotive on the center line of the leading truck. The two high-pressure cylinders are placed between the frames and the two low-pressure cylinders outside the frames. The high and low pressure cylinders of each pair are cast in one piece with the corresponding steam chests, and the two groups of cylinders are bolted together. The four cylinders are all connected to the forward axle. The cranks of the high pressure and low pressure cylinders on one side are set at 180 degrees to each other, while the cranks of the two high-pressure and two low-pressure cylinders are set at an angle of 90 degrees to each other. The purpose of this arrangement is to secure as good balancing properties as possible. This means steadiness of running at high speeds.

ADAPTED TO HIGH SPEED AND TO MARINE ENGINES.

There seems to have been some idea at the outset in engineering circles here that this poppet-valve gear was not adapted to high speeds. This idea, I learn, is now entirely refuted. The advantage of the system, from the American view point, lies in the fact that it can be adopted on old locomotives as well as on new, and it is unnecessary to point out that if American locomotives are to successfully compete in the foreign field, they must possess economical features equal to those afforded by the Lentz poppet-valve gearing.

This gearing is being adapted to marine engine use. I understand that the Germania Works at Kiel (Krupp) have acquired the rights in Germany for the marine utilization of this design. I understand that new machinery designs for German war ships include this type of valve gearing.

THE HOHENZOLLERN A. G., LOCOMOTIVE WORKS.

The locomotive shops of the Hohenzollern A. G., Grafenberg-Düsseldorf, were visited on March 3, 1908. That plant was then employing 1,400 men. For the year 1907 this firm turned out 110 locomotives. The greatest number built in one year was about 140. At the present rate of working the output for 1908 will exceed the best year's result. The Hohenzollern shops employ almost exclusively plate-frame construction. The plates are cut out by a punching machine in contradistinction to the oxygen-gas cutting employed by the Borsig works and the press-stamping works of the Breslau shops.

More English tools were found in the shops of the Hohenzollern than in any one plant visited in Germany. The makers of these English tools include such firms as Craven Brothers (Limited), B. & S. Massey, and Smith & Coventry, of Manchester. The English tools were for the most part heavy planers and drill presses.

The list of tools of American make included machines from Davis & Eagan, and the Cincinnati Milling Machine Company, Cincinnati, Ohio; Springfield Machine Tool Company, Springfield, Ohio; Warner & Swasey, Cleveland, Ohio; Hendey & Co., Torrington, Conn., and Jones & Lamson, Springfield, Vt.

The German tools included such firms as Werkzeugmaschienenfabrik vorm. Lindermann & Stier, Collet & Engelhard, Ludwig Loewe A. G., Schmaltz of Offenbach on the Main; J. E. Reinecker of Chemnitz; Haniel & Lueg, and de Fries & Co., Düsseldorf.

DEVELOPMENT OF GERMAN TOOLS.

The English tools employed were installed not later than ten years ago. They are distinctly locomotive-working machines, and of a type familiar in the United Kingdom shops. These particular English tools at the Hohenzollern works represent about the last of a heavy shipment of English tools to Germany, for the reason that during the past twelve years German tool development has rendered German manufacturers practically independent of the British works.

The firm of J. E. Reinecker, of Chemnitz, have a very heavy representation of milling machines in the Hohenzollern works. These Reinecker machines are, for the most part, special in type and were evidently designed for locomotive work. The Hohenzollern people mill practically all engine parts, and there is less grinding work done than one would expect to find. De Fries & Co., of Düsseldorf, also contribute special machines for axle work, but aside from De Fries and Reinecker tools there were no special tools in evidence for the locomotive work.

At the Hohenzollern shops, the same as at Borsigs and The Hannoversche Maschinenbau, all fire boxes and staybolts are of copper metal. For riveting, the tools of Hainel & Lueg, of Düsseldorf, are used; these are hydraulic riveters.

The Hohenzollern firm use Pielock & Schmidt superheaters, but I could not learn of any special valve gear being employed. This firm is now turning out locomotives for Holland, Scandinavia, and the Indian Railway. No French contracts are in hand.

The expert tool men receive, on an average, 70 pfennigs (16.6 cents) an hour. The company houses about 140 of its people and the policy in vogue promises an extension of the house-renting system. The work and finish on Hohenzollern engines are of high order.

OPINIONS OF LOCOMOTIVE ENGINEERS.

It has been my practice, whenever opportunity presented, to have a chat with the engineers of the high-speed locomotives on the Prussian state railways. These men are for the most part clever and intelligent, and exhibit a certain self-reliance which might be expected of men in their calling. They seemed ready to discuss locomotive points, and did not hesitate to ridicule some of the earlier types of locomotives now in service on the state railways, and even some types of late date are criticised by them. Invariably, however, they praised the Lentz poppet-valve gear and say that it gives no trouble, and where used with superheated steam is a great saver in coal. The testimony of the locomotive engineers should be regarded as valuable. These same engineers said that briquettes are poor fuel for high-speed locomotives, as they pack too hard on the fires and do not admit of the spread which can be obtained with loose coal.

FEED-WATER HEATERS—STEAM PRESSURE.

It would seem as if the German locomotive builders have not up to the present gone extensively into the question of feed-water heaters, and so far as information is obtainable among the Prussian shops feed-water heaters are only made by one or two firms which have studied the matter specially. The Metcalf type of feed-water heater is about the only one that seems to be generally known on the Continent. A new feed-water heater was being developed in the spring of 1908 by the Hanover locomotive shops.

The experiments made with a new type of feed-water heater in the spring of 1908 by Mr. F. H. Trevithick, in the Egyptian state railway service, have been closely followed in Germany. I learn from Mr. Trevithick that exhaustive trials were carried out, which indicate that engines fitted with the new heaters consume 19 per cent less coal and evaporate 26 per cent more water than without them. I understand that the North British Locomotive Company, of Glasgow, is bringing out engines fitted with this new device.

It is the aim of the Trevithick design to raise the temperature of the feed water by the aid of the surplus exhaust steam and smoke-box gases, and to prevent the emission of sparks. The feed water is raised to boiling point by circulating among tubes of the surplus exhaust-steam heaters, which directly communicate with the cylinder exhaust port, and is further raised to an average of about 260° F. by circulating among the tubes of the water in the smoke box, through which the furnace gases pass on their way to the funnel. The emission of sparks is prevented by drawing the gases through a wire netting sieve, which retains and deposits the ashes in a box.

THE HEATERS TESTED.

The evaporation capacity of the heaters has been tested in comparison with an engine not fitted with this device. As a result of four trips on the Cairo-Alexandria expresses it was found that the temperature of the feed water from the heaters, which was recorded every five minutes, averaged 260° F. The boiler of the engine fitted with heaters was therefore supplied with water at this temperature during the evaporation test, which took place in the Boulac shops. The results show that the evaporation was greater under atmospheric than under boiler pressure, and that in both cases it was 26 per cent more with the heaters than without them.

As a result of 28 round trips, approximating 7,280 miles on the Cairo-Alexandria expresses, it has been found that the economy following the use of the heaters exceeded 22 per cent. I understand Mr. Trevithick was of opinion that an engine fitted with the heaters would take similar trains with 20 per cent less coal than the same engine without them, or with the same coal the former would take 25 per cent more load than the latter. It was for the purpose of ascertaining the correctness of this view that careful observations were made, with the result of 22 per cent above quoted. It is stated that the heater tubes of this engine, numbering 671, were only one-half inch in the bore. These tubes were used solely for experimental purposes. It is stated that the feed-water temperature exceeded that of another engine fitted with heaters by about 20° F. The latter engine was supplied with 188 tubes of 1-inch bore. I am advised that the spark arrester has proved very satisfactory. It is claimed that it entirely obviates all sparks, in no way impedes the draft, requires no attention during the run, and that the ash box has never been found full at the end of the journey.

EVAPORATION CAPACITY.

In the case of a test for the evaporation capacity of a boiler of the engine fitted with heaters, as compared with that of the boiler of an engine fitted without them, the conditions of the two boilers were made as identical as possible. Both boilers were given a thorough cleaning, a new set of tubes, a set of similar fire bars, and a new similar brick arch and deflector plate. Both engines were provided with similar steam blowers. The blowers consisted of inch piping formed into 9½-inch diameter rings, containing 30 holes drilled to one-eighth parallel drill. The coal used was Welsh steam, hand picked and sorted into sacks of 100 kilos just before the test commenced. The tender tanks were duplicates and were fitted from top

to bottom with a glass tube calibrated to 50 gallons. The boiler water gages were marked to half glass.

To eliminate lighting up coal in the case of the test at boiler pressure, the boilers were previously steamed, while in that of the test at atmospheric pressure they were simultaneously filled with boiling water. To do this a steam heater was used, one end being connected with a water main and the other to the blow-off cocks of the boilers under test. The steam from the shop boilers, passing through the heater tubes, boiled the water as it circulated among them on its way to the boilers under test. To feed the boiler of the engine fitted with heaters during the test with water resembling in temperature that at which it is supplied when on the road, namely, 260°, its steam heaters were connected to the shop boilers. In the connecting pipe was placed a regulating valve, which, with the aid of the smoke-box heater, allowed the boiler to be supplied with water at the desired temperature. To record the temperature, a thermometer was placed in the feed-water pipe, attaching to the usual boiler clack box.

ATMOSPHERIC PRESSURE.

In the case of the test at atmospheric pressure the trial commenced at the first lighting-up, but in the second and following test the coal used in raising steam to boiler pressure formed no part of the trial, which only commenced after steam had been raised and the fires dropped and relighted. In all tests the water in the boiler was raised to the half-glass mark on the gage glasses before the final lighting-up, after which the water in the tender tanks was raised to zero in the calibrated glass gage, namely, the full tank. The water consumption, smoke-box temperature and vacuums, and the feed-water temperature of the engine fitted with heaters were recorded every five minutes throughout the test. The pumps were worked throughout at such a constant speed as to just maintain the water in the boilers to the mark on the gage glasses.

Toward the end of the trials the pumps were stopped and the fires allowed to completely burn out. They were then again worked to raise the water to the fixed mark on the gage glasses, after which the final reading of the tender tanks was recorded. The result of the trials showed that the draft in the funnel chamber in the smoke box fitted with the heater was double that in its central or boiler-tube chamber, while the draft on the fire of the two boilers was practically the same. It was also shown that the amount of ashes drawn into the smoke box without the heater was double that drawn into the smoke box with the heater, and that 100 out of 238 boiler tubes were put out of service without adverse effect on the evaporation, and with an

increase in the temperature of the smoke-box gases, and in the amount of heat absorbed from them in their way through the heater, amounting, respectively, to 75° and 45° F. It was further shown that the evaporation was greater under atmospheric than under boiler pressure, and that in both cases it was 26 per cent greater than without the heaters.

STEAM CONSUMPTION COMPARED.

During these evaporation tests advantage was taken of the opportunity to compare the steam consumption of the single-acting Weir pump on the engine fitted with heaters with that of a double-acting pump. The latter was installed on the engine not supplied with heaters. To make the comparison, a heater was temporarily placed between the pump and the tender tank, through which tubes the exhaust steam from the pump passed, and among which the feed water circulated. The heater was 6 feet long by 6 inches diameter, and contained 26 ¾-inch tubes. In one test the exhaust steam from the pump entered at one end of this heater and passed out at the other, and in its course raised the temperature of the feed water only 12°, viz, from 62° to 74°, while the water of condensation left the heater at 134. To utilize more of the heat of this condensation water, thin plates were fitted to each end chamber of the heater, so as to cause it to traverse four times through successive rows of tubes, with the result that its temperature on leaving was about the same as that of the feed water, namely, 92°, thereby showing that the exhaust steam had been used to its fullest extent, and that it is capable of raising the temperature of the feed water about 30°, that is, from 62° to 92°. It is stated that the amount of steam used by the single-acting pump was 2.09 per cent of the total boiler evaporation as against 2.63 per cent in the case of the double-acting pump, and that the condensation water of the former weighed 515 pounds while feeding the boiler with 24,700 pounds of water, as against 524 pounds of condensation water while feeding the boiler with 19,800 pounds of water in the case of the latter.

FIRELESS LOCOMOTIVES.

The Germans are turning out a fireless locomotive, which in point of simplicity, ingenuity, and economy is thoroughly characteristic of their nation. Within a comparatively short time this type of locomotive was unfamiliar to some of the best locomotive men in America. This fact is mentioned as indicating that Americans are not watching foreigners, and especially the Germans, close enough for our own advantage. This fireless locomotive is not only a success but is practically the only type of motor power which can be recommended for

plants where the question of fire precaution is almost a first consideration, as, for example, powder mills, cotton plants, wharves, and other places where the presence of an ordinary type of locomotive, or even electric power, prejudices the insurance.

Having had occasion to ride on one of these fireless locomotives, its simplicity was noted. This can be understood from the fact that in the cab the mechanism consisted merely of a throttle bar, reversing gear, and brake. Only one man was required to run the machine, thus saving the expense of a fireman. Both A. Borsig, of Tegel, and the Hannoverische Maschinenbau Aktien-Gesellschaft, of Hanover, are manufacturing these fireless locomotives, and, in the case of Borsig, many orders are being received for the type. From one firm alone an order for 8 locomotives was received, and lately the Prussian State Railway has taken up the type for special service.

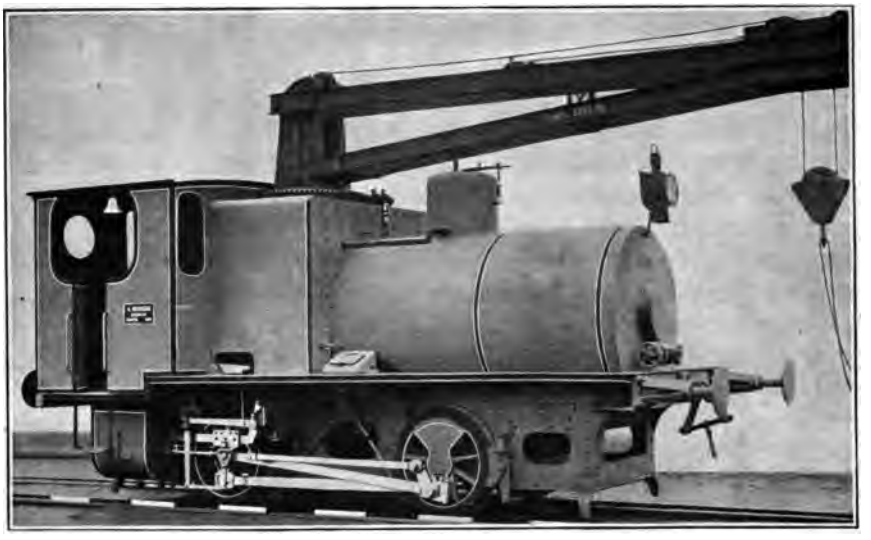

FIG. 14.—Fireless locomotive.

NO FIRE BOX ON THE LOCOMOTIVE.

As the name implies, the locomotive is fireless. There is no fire box. In general appearance the machine resembles the ordinary type of locomotive minus the fire box, funnel, and sundry other attachments. It must be understood that this type of locomotive is unsuitable for uninterrupted railway service, but is essentially a yard-shunting machine; in other words, it must keep near its base of supply, and this base of supply is the boiler of some local power station. At this local power station the tank of the locomotive is filled with steam, and on this steam supply the machine will run from four to five hours doing

ordinary switching work. When I entered the cab of the switching engine at Borsig's the steam gage showed a reading of 45 pounds. I was informed that two hours had elapsed since the boiler was charged and that steam was taken on at 170 pounds pressure. The chief engineer of the works stated that the boiler could limp back to its station even with steam pressure as low as one-half an atmosphere.

Contrary to one's natural impression, steam is not taken on at high pressure. The pressure is about 170 pounds per square inch; in other words, it is proposed to afford the locomotive a steam pressure practically the same as that in the boiler of the power station. In order to effect this result the locomotive boiler is filled with water to about three-fourths its capacity. This water is superheated. Steam is admitted by means of a steam coupling from the power plant at the forward end of the boiler, where low down it passes through a steam admission valve. This juncture between the locomotive boiler and the boiler of the power plant is effected by either a revolving pipe connection or by means of a swaying arm, or it may be effected by a collecting pipe such as is peculiar to hydrants.

STEAM MIXED WITH WATER.

The steam on entering is mixed thoroughly with the water in the boiler tank, and the effect is to raise the tension in the locomotive boiler practically to that prevailing in the boiler of the power station, the difference being only about one-half an atmosphere, provided that the juncture is effected in the immediate neighborhood of the steam boiler and that there is little loss of tension through any great extension of pipe. Should the water in the tank be greater in quantity than three-fourths the capacity of the boiler, the quantity of heat available for work will certainly be greater, but, on the other hand, there will be the drawback of wet steam ensuing. Naturally, where there is a constant decrease in steam tension, the cylinder must be comparatively large in diameter, so that even at tensions of 3 to 4 atmospheres in the receiver the friction weight of the locomotive may be utilized to full extent. It is found in practice that even at tensions of from 1 to 2 atmospheres considerable work may be accomplished, and at tensions of one-fourth to one-half an atmosphere the locomotive is still able to go to the filling tank.

The refilling of the engine takes from eight to fifteen minutes each time, but this depends on the size of the receiver and on the fact whether the available stationary boiler can supply sufficient steam during this time.

The size of the locomotive naturally depends on the work to be performed, and in determining a type for any particular plant not only

must the work be taken into consideration, but the size of the receiver must be sufficiently large to obviate too frequent fillings during the working hours. With a properly designed locomotive for normal conditions of work all necessary switching should be effected without having to refill the engine except during the noon hour. At the same time there should be sufficient margin in size allowed the boiler tank to meet any overwork that may be imposed. The Borsig engine, which I had occasion to examine while in service, seldom required to be filled, I was informed, oftener than once in four hours.

HIGHEST POWER ALWAYS AT THE START.

Speaking generally, this fireless locomotive is really an accumulator engine, the necessary power for which is supplied by a quantity of heated water, the temperature of which is equal to a certain steam overpressure. This water supplies the steam for the engine. It goes without saying that in default of fire the steam development is effected at the expense of the heat contained in the water, and the engine works with a constantly decreasing power. When steam is brought from the boiler of the stationary plant to the locomotive it is precipitated in the cooler water of the engine boiler and gives up its heat to the same until the temperature and pressure in both boilers are nearly the same. This is the exact reverse of the evaporating process during the working of the engine, and it results therefrom that, putting aside the probable water losses through leakages and such reasons, the water level in the boiler, after filling up, will always remain the same without the water being actually admitted. Since each engine is only provided with a certain amount of energy, its radius of action is limited.

The construction of the engine is in itself simple. The most important part is the receiver containing the water which is to be heated. This tank is cylindrical in form and is fitted with rounded ends at both extremities. There is a manhole opening in the main wall to permit of access to the interior. The tank is, according to its dimensions, divided up into compartments by means of plate partitions. The connections between these partitions are by means of very small openings. This arrangement is for the purpose of reducing the effects produced by fluctuations in the large water quantity occasioned, both in running and by sudden stops. There is a steam dome containing the regulator for the steam supply, which is located in the usual box common to locomotives.

The Borsig locomotive was especially well protected; in fact, with 45 pounds of steam in the boiler, I found the outside casing of the boiler cool, and I was assured that when the boiler is not running the loss in tension per hour does not exceed one-half an atmosphere,

and is more generally one-fourth atmospheric pressure. During the night the locomotive is brought to a closed shed where these losses are still further reduced.

ABSOLUTE SAFETY AGAINST FIRE—LOW WAGE EXPENSE.

There is no question but that the fireless locomotive is in demand by European firms; and for some of our government plants and at those private establishments where fire protection is a first consideration this type of motor power should prove of great value. Summed up briefly, this type of engine offers absolute safety against fire which might be caused by flying sparks, and all smoke nuisance is eliminated. This permits of the machine being used in sheds and other inclosures. There is marked economy, since the cost of producing steam in stationary-boiler plants is less than when produced by ordinary fire locomotives. The fact must not be lost sight of that only one man is required to run the engine, and when the machine is not in operation the services of this man can be utilized elsewhere. This latter point must be borne in mind when making an estimate on the wage expense of the engine. The expense should be reckoned on the basis of the actual number of hours the attendant is employed on the engine. Practically there are little or no repairs needed on one of these machines; since there is no fire box the strain on the boiler is practically nil. Borsigs say that any incrustations which may develop need not be removed, as such deposits, by serving as calorifuge, assist in reducing the radiation of heat. The engine can be made ready for service in a very short time, and when once charged is ready for work at a moment's notice. If it is not required constantly the machine may be left standing without supervision, and even after the expiration of several hours it can be brought into play. From this it will be seen that the special province of this type of machine is interrupted work. Since the machine is independent of electric current it can be operated over any line of tracks adapted to its gage, and in point of safety it is probably unexcelled. There need be no fear of an explosion, as the steam tension in the receiver after filling up only decreases and never increases.

FORMULA AS TO STEAM.

The steam quantity which theoretically may, subject to temperature limits, be taken from the hot-water boiler, works out, according to the Borsig engineers, in keeping with the following formula:

Supposing that P_1 stands for the water quantity and t_1 for the temperature of the water in the boiler after it has been newly filled, P_2 for the water quantity and t_2 for the temperature in the tank after the work has been completed, the quantity of heat in the beginning will be $P_1 . t_1$ and in the end $P_2 . t_2$;

the difference between $P_1 . t_1$ and $P_2 . t_2$ has been employed for the evaporation of the water quantity $P_1 - P_2$.

Further, if r stands for the evaporation heat at medium temperature, the following equation will be obtained:

$$P_1 . t_1 - P_2 . t_2 = (P_1 - P_2) . r$$

and the result will be

$$P_2 = P_1 \frac{t_1 - r}{t_2 - r}$$

At given temperature limits it is therefore possible to estimate the final water quantity out of the initial water quantiy.

Further, if the steam quantity (D), which the engine consumes per each horsepower and hour, is known, the following fraction will be obtained

$$\frac{P_1 - P_2}{D}$$

which states the number of hours and horsepower which the engine is capable of working with one filling. The steam quantity D may be supposed to be 22 kilos per horsepower and hour. This figure is based on numerous tests and by bearing in mind the loss of heat through leakage and radiation of heat. The receiver only ought to be filled with water up to three-fourths, while the rest of its volume must be reserved for the steam.

In one type of Borsig's engines, known as No. 6, the locomotive boiler has a capacity of 9 cubic meters. This boiler holds, therefore, about 7,000 liters of water (liter=1.05 quarts). Supposing a steam pressure of 12 atmospheres in the stationary-boiler plant, the initial pressure in the receiver may then be supposed to be 11 atmospheres. Should the working capacity of the heated water be utilized to such an extent that the tension in the receiver is reduced to 2 atmospheres, the following quantity of steam, in conformity to the above formula, will be required for the refilling of the receiver until the initial tension of 11 atmospheres will be arrived at:

$$P_2 = 7000 \frac{183 - 497.5}{119.6 - 497.5} = 1176 \text{ kilos of steam.}$$

It results therefrom that, at a steam consumption of 22 kilos per horsepower an hour, the locomotive, when being filled up to the above indicated tension limits, may have an efficiency of 53 horsepower hours. The steam consumption, as well as the efficiency of any fireless locomotive may be estimated, it is stated, on this last formula in any case which arises.

FRANCE

MACHINE-TOOL TRADE IN FRANCE.

THE WORKS OF H. ERNAULT, AT PARIS.

MODERN BUILDINGS AND FOREIGN TOOLS.

The machine-tool works of H. Ernault are among the best in France. The plant is essentially first class. It was no surprise to learn this on the occasion of my visit, May 27, 1908, as I had observed Ernault's tools extensively in up-to-date European installations. The Swiss and Italian shops in particular have drawn liberally on this French firm, and there are few automobile establishments on the Continent which are not using Ernault's horizontal boring machines. The shops are located within the city of Paris. The main building is comparatively new, and is a handsome modern structure of steel and concrete. The light in the main shop is almost as good as out-of-doors. The flooring is of blocks, but under the tools there is a concrete foundation. The machines are all arranged in battery form, and the high class of tools employed may be appreciated when it is known that there are in use no less than 45 Brown & Sharpe machines, which are for the most part millers. They also have 11 Gleason gear planers, which are in high favor here.

AMERICAN AND FOREIGN TOOLS.

Among the American makes the following firms are represented:

The Fellows Gear Shaper Company, Springfield, Vt., shapers; F. E. Reed Company, Worcester, Mass., lathes and planers; Whitcomb Machine Tool Company, Worcester, Mass., shaper; Bullard Machine Tool Company, Bridgeport, Conn., boring mills; Pratt & Whitney, Hartford, Conn., lathes; Brown & Sharpe Manufacturing Company, Providence, R. I., general line of tools; Potter & Johnston Machine Company, Pawtucket, R. I., automatic turret chucking and turning machines; Gleason Company, Rochester, N. Y., gear planers; Niles-Bement-Pond, New York, planer; the G. A. Gray Company, Cincinnati, Ohio, planers; National Acme Machine Tool Company, Cleveland, Ohio, automatics; Warner & Swasey, Cleveland, Ohio, vertical miller; Bickford Drill and Tool Company, Cincinnati, Ohio, drills; Baker Brothers, Toledo, Ohio, shapers; W. F. & J. Barnes Company, Rockford, Ill., drills; Gisholt Machine Company, Madison, Wis., turret lathes; Walcott Machine Tool Company, Jackson, Mich., shaper.

There are 7 Gisholt lathes in service and 6 of Potter & Johnston's late design machines. Eleven Reed planers and 4 Bullard machines are at work. The Pratt & Whitney lathes numbered 4 in all. The planer from Bement-Niles has a table measuring 10 meters long.

Among the foreign tools there were to be observed machines from the following: Wanderer Works, and Biernatzki & Co., both of Chemnitz; Ducommun, Schmaltz, and Alfred Herbert. The opinion was expressed here that Wanderer makes the best milling machine in Germany. The Gray planers are highly praised. There have probably been more attempts to copy Gray planers in Europe than any other American machine tool, but in no instance, so far as I have discovered, has the copyist been able to assemble his machine properly, or to even approximate the original in point of workmanship or ability to obtain with the copied tool as accurate work as with the original. The Gray planer is generally referred to as an expensive machine, but notwithstanding this fact it seems to command ready sale.

CHARACTER OF OUTPUT—WAGES AND HOURS.

Ernault is building vertical milling machines and also universal millers. He is specializing on the Kreutzberger system of universal grinding machines. The general line of tools built by Ernault comprises lathes, millers, and horizontal boring mills. Ernault is making both turret and engine lathes. I have no hesitancy in saying that his boring machines are splendid tools. The general output is high class, and it is reasonable to expect that this establishment will command a good share of business. American machine tools are in high favor at Ernault's shops.

Ernault is now employing about 300 men. A day's work comprises ten hours, and payment is for the most part by piecework. The tool drive is at present by steam, but I was informed that electric power will soon be thrown into the shops. It is stated that Ernault's double horizontal boring machine has been sold in France for 5,880 francs ($1,135). This machine will do credit to any shop, and, as I have indicated before, it seems to come more directly in competition with our American tools than any of the other Ernault outputs. This tool measures on the table 800 millimeters wide by 900 millimeters long. The circular pivot is graduated in 360°. The total weight of this tool is 3,200 kilograms.

WORKS OF THE SOCIÉTÉ FRANÇAISE DE MACHINES-OUTILS.

The Société Française de Machines-Outils, whose new machine-tool works are being erected here in St. Ouen (Seine), has been capitalized in the sum of 6,000,000 francs. The organization is French throughout, and the purpose of the new company is to gain for a French establishment a portion of the machine-tool business which now goes to foreign firms. The active directing head of the company's shops is M. Nardin, an engineer of experience both in technical and in administrative work. M. Nardin has been for a number of years

connected with the Ducommun Works in Mülhausen, whose tools are found in many of the best plants in Europe. Prior to the war with Germany the Ducommun was a French establishment, but with the acquisition of Alsace by Germany it became German. Instead, then, of French arsenals, French railway shops, and other French machinery establishments buying French tools from Ducommun, they were placed in the position of importing German tools whenever they purchased from the Mülhausen plant. In these circumstances it was determined to form a French company with sufficient capital and resources to insure success. The work of erecting the new shops was commenced about one year ago, and the plans contemplate a progressive development.

TOOLS FROM AMERICA.

The new shops at St. Ouen are built of steel and concrete. They are handsome designs, and there is no question that M. Nardin has taken advantage of some of the very best ideas to be found to-day in use in progressive plants. To judge by the way new tools are going into the shops this new French plant will probably be in position to work 250 men by the end of the year. This assumes that orders are forthcoming, and it was stated that the new company is largely relying on government patronage. The opinion prevails at the shops that they will be working 800 men before three years have elapsed. They will certainly need to work that number if they are to realize a fair profit on the amount of money invested. This statement is based on the earning capacity of tool operators, taking for mean average a large number of standard machine-tool houses in Europe.

A number of the machine tools which are being installed at St. Ouen are coming direct from America without reference to the local agents. Several tools were pointed out which were purchased through third parties in America and shipped to France without the knowledge of the makers as to destination. The statement was made that the new shops had saved about 100,000 francs through ignoring agents and buying through third parties in America. This will probably be news to some of our manufacturers. There is one firm of agents in France which is doing its best to uphold American prices. This firm can not be induced, it is said, to give even a 2 per cent discount on a thirty-day payment where American machine tools are involved, and the firm has lost business in several instances because it has preferred to stand by its principles.

SPECIAL TOOLS CONSTRUCTED.

The new St. Ouen shops are undertaking to build lathes of 8 inches, 9 inches, and 10 inches height of center with double swing, with straight or recessed beds; also standard planers of special lengths.

Monopulley lathes of special sizes will also be built and the headstocks by St. Ouen are designed to be adjusted to ordinary beds. The firm will also build turret lathes of 2-inch, 2½-inch, and 3½-inch sizes, automatic dowel-pin machines, and automatic chucking and turning machines. The lathes are the first part of the construction programme, but other machines are to be built, including gear planers, grinding machines, milling machines, and boring mills.

The lathe as designed by St. Ouen has a single pulley and only one handwheel. With eight positions of handwheel there result eight following speeds and the lever motion permits of a doubling of these eight speeds. An electric apparatus attached to this lathe permits of reversing in half a second. The electric reversing gear is a special patent of the St. Ouen shops. It is also proposed to make planers with single pulleys and variable speeds. This firm will sell, I understand, the 9-inch height of center lathe with 8-feet length of bed for 3,000 francs. The same price is charged here for a Hendey lathe having a 7-inch height of center and 6 feet length of bed. The selling price quoted for the Hendey machine is stated by the St. Ouen shops to be the selling price of the Paris agent. The Hendey tool is said to have about one-half the weight of the one made by St. Ouen. The turret lathe of the St. Ouen shop resembles very closely the Jones and Lamson standard tool. It differs in having a fixed headstock and a change speed without friction.

M. Nardin repudiates any assertion that his firm purposes to copy American machine tools, and says that since his firm can not logically begin with primitive methods it is necessary to commence at a point at which others have to-day arrived.

FOREIGN TOOLS REPRESENTED.

A Kendall & Gent (English) double-spindle drill was observed in service here. A new planer from Batemans, of Leeds, England, was in operation, the day of my visit, for the first time. There was some doubt expressed regarding its qualities. Evidently this tool had been installed in the hope that it would render good service. It was working not far from a Gray planer, and the comparison was obvious. Still another English make is represented by the firm of George Richards & Co., of Broadheath. This firm supplied a side planing machine, having a long side shaper. Alfred Herbert, of Coventry, has supplied a hexagonal turret lathe. There was also a copy of a Gray planer installed, the make of a German firm, and in answer to an inquiry as to whether the latter tool was satisfactory, there was merely a significant shrug of the shoulder. The trouble encountered by firms which attempt to copy is that they can not always duplicate workmanship. So long as Gray maintains the present high standard of workmanship in his shops he has, in the writer's

opinion, little to fear from the attempts of those who merely copy. The latter are followers and seldom leaders. Jones & Lamson, of Springfield, Vt.; Warner & Swasey and Lucas, both of Cleveland; Pratt & Whitney, of Hartford; Bickford and G. A. Gray, of Cincinnati; Brown & Sharpe, of Providence; Mark Flather, of Nashua; Bullard, of Birdgeport; F. E. Reed, of Worcester; Kearney & Trecker, of Milwaukee; Norton Grinding Company, of Worcester, and the Fellows Gear Shaper Company, of Springfield, Vt., are all represented in the new equipment which is going in the St. Ouen shops.

Among the firms represented were also Bouhey, Ernault, P. Huré, and Bariquand & Marre, all of Paris; Lubin & Wieffenbach, of Clichy; Lud. Loewe, of Berlin; Werkzeugmaschinenfabrik Oerlikon, of Zurich; Ducommun, of Mülhausen, and the Wanderer works and Reinecker, both of Chemnitz. The Clichy firm has furnished tools for cutting deep keyways on arbors, and Wanderer has supplied special machines for turning out graduations on verniers. Kearney & Trecker tools are well spoken of. This firm has furnished millers. One of the Fellows's gear shapers was received with its main foundation foot broken. The tool was repaired by the St. Ouen shops.

A horizontal boring machine from Werkzeugmaschinenfabrik "Union," of Chemnitz, was also observed.

It is the writer's opinion that the new French works are in a fair way to do considerable business. There is a strong national feeling which must be reckoned with, and the wonder is that the French have not attempted something of this sort before. The French workman is clever with a tool, and under proper direction is capable of turning out first-class work. The future of the St. Ouen shops, however, will depend very much on the technical knowledge displayed in the designing bureau. As pointed out in previous reports, the success of one machine-tool house over another depends mainly on technical knowledge and first-class workmanship. Any shop which attempts only to copy can never be regarded as a serious competitor. The writer believes that the St. Ouen shops will display originality, and that the future development of these works promises more than ordinary interest to our machine-tool manufacturers.

THE WORKS OF BARIQUAND & MARRE.

SHOPS IN HEART OF PARIS—LINE OF TOOLS CONSTRUCTED.

The French machine-tool house of Bariquand & Marre, of rue Oberkampf, Paris, was working on the occasion of my visit on June 9, 1908, about 700 hands, of whom about 100 are women. Admission is gained through an archway in a long row of city buildings and in the rear are found five stories of shop works. The attention of the writer was attracted to Bariquand & Marre's tools first in

Italian installations, and machines of this make have been found in practically all of the principal shops of France. The firm builds a large variety of tools of small and middle sizes. During a visit to the works, under escort of Director-Engineer M. Monnier, it was found that in addition to tool making Bariquand & Marre are turning out a lot of specialties, and it was stated that there was an annual output of about 300,000 metal hair clippers. A large proportion of these clippers are exported to the United States. M. Monnier explained that the reason for manufacturing goods other than machine tools is the lack of sufficient business in France to warrant specializing.

VERTICAL MILLERS AND GAGES.

Bariquand & Marre are most popularly known through their line of small vertical millers. I observed a special machine for straightening rods, and witnessed a bent and twisted copper rod rolled out of this machine faultlessly straight. The rod is bent over in a small pipe, which it enters at a small angle, and then is rolled between the sides of three rolling rods. I understand that No. 2 size of this machine is sold for about 1,200 francs ($223.60). Whereas the old shops of Bariquand & Marre are dark and gloomy, the new shop recently constructed possesses plenty of light, and is modern in design. It is in this new shop that Mr. Wilbur Wright undertook certain work for his new aeroplane.

In addition to the machine tools, Bariquand & Marre are manufacturing instruments of precision, and are doing a first-class business with the French Government in supplying gages of all descriptions for arsenal inspection works. The star gages manufactured, and the rocking screw and bolt gages, are especially fine. The standard screw gages of the French railways are of Bariquand & Marre make.

VARIETY OF OUTPUT—WAGE AND WAGE-EARNERS.

The principal tools manufactured by Bariquand & Marre comprise a full line of small vertical drills and millers, horizontal milling machines, combined horizontal and vertical milling machines, small bench lathes, engine lathes of small and middle sizes, chucks, turret lays, slotting machines, grinders, rod-straightening machines, oil extracting machines, and a full line of gauges. In addition gear cutters, drills, reamers, taps, and dies are made.

A firm like Bariquand & Marre may be expected to cater directly to the numerous small shops where only light work is handled, but at the same time it should be borne in mind that this firm is turning out lathes and milling machines capable of handling the ordinary work required of middle-size tools. I have found many Bariquand & Marre's lathes installed throughout France, and for the work imposed on them these tools were apparently doing good service.

POPULARITY OF MILLERS.

The small vertical millers, as remarked before, are popular tools among the French works, and it would seem that Bariquand & Marre have specialized more on this form of tools than most other European firms. German firms, as stated in previous reports, have specialized on some of the heavier sizes of vertical miller, and it has been noted abroad that there has not been presented from America a good line of vertical millers. Bariquand & Marre's shops are hard working, and could be depended on to turn out a large amount of material annually. In the small tools this firm appears to have very little competition from the United States.

The statement was made that there was some advantage in having the works located in the city proper, since it enables the firm to obtain help with the greatest facility and at the lowest possible rates. The women employed in these works receive only about 3½ to 5 francs (67½ to 96 cents) per day. This is much lower than the wages demanded by men. No American tools were observed in service in the shops, with the exception of three Landis grinders. Two tools of English make were seen, one being a horizontal borer from Kendall & Gent. All other tools were of Bariquand & Marre's own make, or French manufacture.

THE HURÉ WORKS.

FABRICATION AND USE OF TOOLS OF SPECIAL DESIGN.

One of the best machine-tool houses in France is the firm of P. Huré, located at Paris. I visited these works on June 11. This establishment is at present building, in connection with its general line of tools, universal milling machines having the miller on the same plane as the table. As is well known, in the case of the plain miller the table slides on a fixed carriage, whereas in the case of the universal miller the carriage swings. Generally speaking, the plain miller is considered stronger, and Huré aims to maintain the strength of the machine by eliminating the pivot of the swinging table. To accomplish this Huré pivots the head to meet all conditions of work. In the head of one of these millers there are three bevel gears, and by adjusting the two graduated slides any position desired is obtained for the spindle. These millers are being manufactured in six different sizes. The smaller size is operated by foot and is provided with ball bearings. It weighs 700 pounds and the cost is $260. The largest size weighs 9,000 pounds, for which the charge is $1,580. Aside from the milling machines Huré manufactures a general line of tools. He informed me that he builds as many as 150 different kinds of machine tools.

TOOLS FROM UNITED STATES.

The following-named American machine tools were observed in service in the Huré shops:

Prentice Brothers Company, Worcester, Mass., drills; Brown & Sharpe Manufacturing Company, Providence, R. I., millers and measuring instruments; Hendey Machine Company, Torrington, Conn., lathes; W. F. & J. Barnes Company, Rockford, Ill., drills; D. E. Whiton Machine Company, New London, Conn., chucks; J. T. Towsley Manufacturing Company, Cincinnati, Ohio, machine shop truck; The Fairbanks Company, steel saws (these saws were probably of West Haven make).

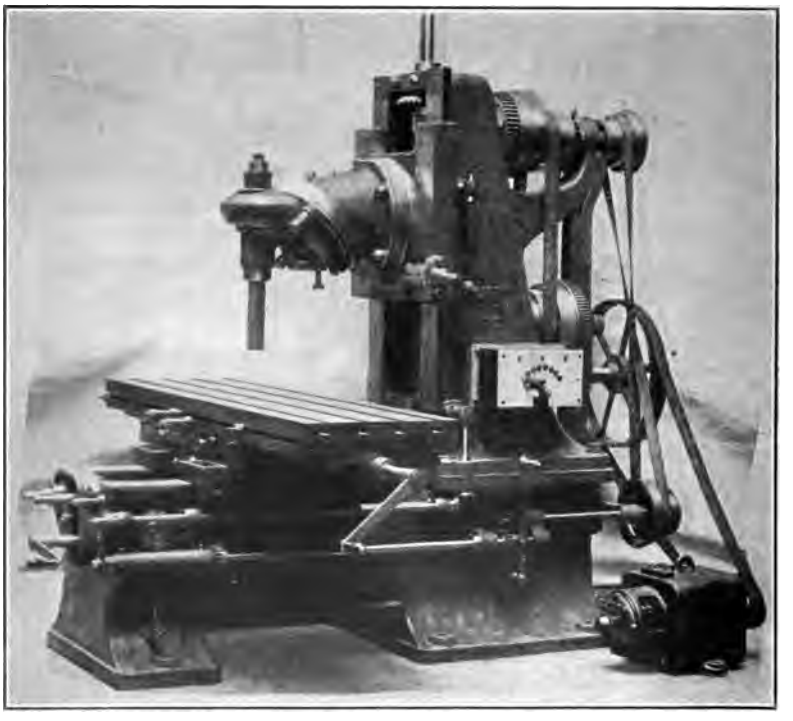

FIG. 15.—Huré milling machine with pivoting head.

The twist drills in service are mostly from the Standard Tool Company, Cleveland, Ohio. I was informed that all tools ordered from the United States were purchased direct. Huré is building a new design of lathe which promises well; the foot and head stock look both light and strong.

TOOLS MANUFACTURED.

For the surfacing work in milling the Huré cutters are fitted with removable blades made trapezoidal in form. Mr. Huré says that it takes about four times as long for the work and costs more, but that

the job is stronger. He criticised the Babbitt metal bearings in one of our American drills, and stated that he believed in cast-iron bearings, provided one uses hard steel. He prefers this to Babbitt metal, and considers that Babbitt is only good when soft steel is used.

The principal line of tools manufactured by the Huré shops comprises lathes, milling machines, and drills. The shops, like those of Ernault's, are progressive and modern. The writer was forcibly impressed by the intelligence and engineering ability displayed here. Mr. Huré, jr., the engineering director of the works, extended me every facility to inspect the shops. Mr. Huré is representative of the progressive younger element, which is now rapidly coming to the front in French industrial life. He informed the writer that he had visited America, and was enthusiastic regarding the opportunities which had been afforded him there. No American manufacturer need hesitate to call attention of firms like this one to tools possessing merit and economy in work.

Huré is employing at present about 400 men in all shops. Men at the milling machines receive about 80 centimes per hour. The working day comprises ten hours and commences at 7 a. m. and closes at 6 p. m. with one hour off at noon. The principal line of tools manufactured comprise lathes, milling machines, and drills.

LEJEUNE & LEVY SHOPS, AT PARIS.

The French machine-tool house of Lejeune & Levy, located in the heart of Paris, is manufacturing a tool of its own design in the shape of an automatic hob and cutter grinding machine. The firm is a small one, employing about 40 men. The above tool cuts a line across the face of the gear teeth instead of milling, and performs the work apparently with accuracy. Patent rights for this machine have been applied for in the United States. Like Bariquand & Marre, Lejeune & Levy find it necessary to manufacture certain lines in addition to machine tools, and some of the tools in the shops are now employed in turning out automobile pinions. My attention was called to a new patent attachment applied on one of Ernault's gear shapers. This device consists of using a cone as a tracer for indexing the work on the gear cutting. I find that the tools of Lejeune & Levy are drawn on by the French arsenals and marine establishments. All the tools in service in the shops requiring other than hand power are driven by gas-engine power.

The new Lejeune & Levy machine is strong and compact, and appears to have much merit. The machine is specially designed for grinding hobs up to 6½ inches diameter by 12 inches long, and formed and spiral milling cutters. The hob is mounted on the mandrel and supported by a back center, and is revolved through a number of degrees equal to the spiral flute, while the longitudinal motion of the

emery wheel, the twisting and dividing motion of the hob, are all obtained from the horizontal shaft carried in the base of the machine. and driven from the countershaft by a three-speed cone pulley through duplex worm gearing.

AUTOMATIC MECHANISMS.

On the horizontal shaft inside the base is a double-walled helical cam which, by adjustable link, gives the reciprocating motion to the

FIG. 16.—Automatic hob and cutter-grinding machine, Lejeune & Levy.

emery-wheel carriage. The latter moves on slides at the back of the bed. The emery-wheel spindle is driven by belt from the countershaft, guide pulleys being interposed, and all running on ball bearings. The head [illegible] set over to suit the angle of lead of the

spiral of the hob, and for this purpose the emery-wheel headstock is mounted in a horizontal socket and can be bolted in any required position, a dial indexed in degrees and half degrees giving an easy means of setting. The headstock itself is carried on a cross slide and can be fed forward to the work as desired. Automatic feed is obtained at the end of the back stroke by means of an adjustable stop or catch on the bed, actuating by means of a lever, ratchet motion, and worm gear to the slide screw, automatic knock-off by drop-out worm being supplied.

Both the automatic dividing of hob and the twisting motion are obtained from mechanism at the left-hand end of the machine. The main horizontal shaft, carried by the body of the machine, has a continuous rotary motion. On the left-hand end is mounted a slip clutch, together with a circular cam having a single tooth. This latter depresses the vertical rod and releases the top clutch, forcing the dividing plunger out of engagement with the division plate and allowing the perforated steel band shown to turn the plate to the next notch, when the plunger is brought into engagement once more by means of a spring. The band is driven by the slip clutch. The twisting link motion is carried at the back by the traveling saddle, giving motion to a vertical rod, which is formed at the top into a rack. This turns a pinion which revolves the hob in the correct directions for the forward and return traverse of the emery wheel, the dividing motion being rendered independent of the twisting motion by the interposition of a free-wheel clutch. The link is graduated so that spiral twist of link in either direction can be given.

The body of the machine is of box section, carrying at the back the necessary gear for the supply of water to the cutter, and having in front a large door by which access can be obtained to the internal cam and shaft. At the lower end is cast a water trough, from which the gear pump is supplied.

PRICES OF FOREIGN-BUILT MACHINE TOOLS.

Some idea of the prices charged for foreign machine tools laid down on the outskirts of Paris may be gained from the figures supplied by purchasers, and which are believed to be correct. One firm states that it paid for a Bilgram gear cutter, fully automatic, next to the largest size, 7,800 francs ($1,505.40). A double horizontal boring machine supplied by H. Ernault, of Paris, cost 5,880 francs ($1,134.84). I understand that there is only one size of this tool manufactured by Ernault. A Ludwig Loewe miller No. 12 m, supplied by Destonbes, Langlays Company, cost 1,290 francs ($248.97). Bariquand & Marre, of Paris, supplied four No. 2 millers to one firm

at 1,700 francs ($328.10) each. No. 1 miller, from the same firm, was purchased for 1,750 francs ($337.75). Two No. 1 vertical millers were purchased for 3,300 francs ($636.90). One of J. E. Reinecker's backing-off lathes was bought for 5,702 francs ($1,100.49), and a vertical miller from the same firm for 4,100 francs ($791.30). One of Reinecker's large size vertical millers cost 5,400 francs ($1,042.20), and one of Reinecker's No. 2 Bilgram machines was delivered for 7,250 francs ($1,399.25). A Richard's "Phœnix" boring machine cost 5,500 francs ($1,061.50), and a Busse No. 1, type "B" machine, of practically the same size, cost 6,200 francs ($1,196.60). A Richard's vertical turret lathe cost 3,800 francs ($733.40), and a Warner & Swasey, Cleveland, Ohio, tool, of practically the same size, cost 6,600 francs ($1,273.80). One firm purchased a Reinecker No. 1 Bilgram gear shaper for 4,375 francs ($844.38). An 8-spindle German-made vertical drill was purchased for 4,400 francs ($849.20). The name of the actual manufacturer is not carried on the machine, but the statements were made that it was purchased of Glaenzer, Perréaud & Thomme, of Paris, and that this latter firm of agents has tools manufactured in Germany for their account.[a]

PROPOSED INCREASE IN DUTIES ON MACHINE TOOLS.

American machine-tool manufacturers need not be surprised if France places a duty on machine tools varying between 13 and 20 per cent. There has always, perhaps, been a strong national feeling in France prejudicial to foreign tools, but probably this feeling is no stronger now than in the past; in fact, there is likely less prejudice now than heretofore. However, it is understood that a number of automobile manufacturers are largely responsible for the efforts being made to foster the development of French machine-tool houses. One of the leading members of this movement is the Marquis de Dion, of the De Dion-Bouton & Co. Automobile Works. It is realized, however, that if these new French machine-tool works are to be encouraged the tariff must be increased. A commission in the interest of French machine-tool makers has been canvassing the entire subject of late, and this commission pointedly refers to the development of the machine-tool industry in America as the outcome, in part, of the tariff system and the natural conditions of the country. It is pointed out that since the elaboration of the French customs duties of 1892 the manufacture of tool machines has become one of the most important mechanical industries, though, as a matter of fact, owing to the want of any customs protection, this industry in France occupies the lowest rank in customs classification.

[a] Prices asked for Pittler machines in Lyons will be found under the report on the Berliet works.

REASONS FOR INCREASING DUTIES.

The commission calls attention to the importance of the French automobile industry in the world's trade, and emphasizes the dependence of this business on machine tools. The French workman, it is declared, is not less skillful than foreign workmen, and his ability to turn out fine machines has been amply demonstrated. Such being the case, the failure to produce high-grade machine tools in France in large quantities is attributed more especially to the economic conditions of the country, and it is declared axiomatic that the development of any industry depends almost exclusively on the conditions of its environment. The French investigators declare that the American and German machine-tool builders have demonstrated the truth of this axiom, that they have found in their respective countries the economical conditions which make profitable the development of tool machines, and that the Americans and Germans have been enabled to overwhelm the French builders to such an extent that the latter are practically dependent on those two countries for the bulk of machine tools.

The economic conditions referred to as existing in America apply to the general demand for machine work over hand work, and to the enormous demand for tools necessary to the construction and exploitation of our enormous railway, iron and steel, and other manufacturing interests. In Germany the progress of the machine-tool industry has been favored by the development of the metallurgic industry of the interior. In France and in England the machine-tool development has kept pace with the development of the needs of the country. Germany has developed her machine-tool industry without much customs protection, but it would seem as if there will be some modification in this respect before long. The new German duties have quadrupled the customs tax on machines weighing less than 250 kilos. On such machines the duties have been raised from 3 to 12 marks. The French recognize that by reason of the large demands in America and in Germany to meet home requirements the manufacturers of the two countries named have found it possible to export with advantage to France.

PRESENT RATES CLAIMED TO BE INSUFFICIENT.

The French tool manufacturers, therefore, demand an increase in the tariff rates, claiming that the present tariff is entirely insufficient. The commission points out that in 1897 the importation of foreign machine tools, according to the customs statistics, amounted to 5,500,000 francs ($1,061,500), and in 1907 it had passed 31,000,000 francs ($5,983,000). The figures indicated do not represent the

exact value of the machines as brought in from foreign countries, especially so since, as pointed out, a great number of tool machines have been imported into France as detached pieces, or as transmission pieces. It is estimated that during the past year nearly 50,000,000 francs ($9,650,000) worth of foreign-made machine tools entered France. The tariff schedule of 1902 divides tool machines into three categories, namely, small and precise, medium, and large. The idea seems to have prevailed that the tariff framers think only the small machine tools can be classed as precise. This the French machine-tool constructors declare is entirely wrong, inasmuch as all machine tools, regardless of size, must be precise. The commission desires to see a tariff classifying machine tools into two great classes: One to embrace machine tools for general use, capable of performing varied work; the other, machine tools designed for working in series on clearly defined work. It is claimed that the first class is now manufactured in France, and that for the second class French manufacturers are dependent on foreign countries. It is further claimed that unless the French tool manufacturers are given adequate customs protection it is impossible to assure success for French firms which may undertake the building of machine tools of the second class. The various laws in France governing shop practice make hand work, it is asserted, dearer by 4 per cent. This refers to the laws which provide better protection to workmen against accident. Then there is the law with relation to apprentices. The eight-hour law will, if put in effect, make production still more costly.

ARGUMENT FOR PROTECTION.

The constructors say that if France does not protect the machine-tool industry actual producers will not set about manufacturing those highly specialized machines for series work, and that in consequence the country will remain tributary to foreign manufacturers. It is asserted that the agents who now handle foreign goods will find it practically as profitable to handle French as American or German tools, and that the importation of 50,000,000 francs worth of foreign machine tools means the loss to France in workmen's wages of about 30,000,000 francs ($5,790,000). The history of the United States, where a duty of 45 per cent is imposed on machinery, is cited as proof that French machine-tool manufacturers could likewise profit by higher protection. Protection, it is claimed, permits American specializing, and specializing admits of the highest form of development. The constructors say that it is absolutely necessary for the French tariff makers to get clear of the idea, which has prevailed in the present tariff, that only small machines are machines of precision, and consequently possess great specific value. All machine tools, ex-

cept such as are employed in heavy foundry work, as a first characteristic, it is claimed, must be accurate, and if the specific value of light machines has increased with the progress of mechanics, that of machines weighing over 1,000 kilos has increased in a far more important ratio. Taking, as an example, a table of specific values of the three categories of foreign machines recently imported by a French builder of tool machines for his own use, it has been found that the average specific value of these machines, comprising turret lathes, etc., when weighing more than 1,000 kilos, is over 3 francs (57.9 cents) the kilo. The French makers of tool machines insist on a minimum and a general tariff as follows:

COMPARISON OF RATES.

For machines of more than 5,000 kilos, a minimum of 30 francs ($5.79) per 100 kilos, and a general tariff of 40 francs ($7.72) per 100 kilos; for machines between 1,000 and 5,000 kilos, a tariff of 40 francs and 50 francs, respectively; for machines between 250 and 1,000 kilos, a tariff of 50 francs ($9.65) and 60 francs ($11.58), respectively; for machines between 100 and 250 kilos, a tariff of 60 francs and 80 francs ($15.44), respectively; and for machines of less than 100 kilos, tariff of 80 and 100 francs ($19.30), respectively, or an equivalent protection of 20 per cent ad valorem. According to the present tariff, a machine weighing more than 1,000 kilos, worth 2,000 francs ($386), pays 100 francs duty. This, it is claimed, is a protection of 5 per cent, which is regarded as insufficient. The rate of protection demanded is an average one, and it is pointed out that the specific values of the machines weighing more than 1,000 kilos, as actually imported, are in most cases more than 3 francs (57.9 cents). It is contended that these machines should now pay a duty of 13 per cent.

The machine-tool makers have drawn up a very elaborate scheme, which they are pressing for adoption, and which aims to prevent the importation of machine tools in parts. The entire subject is gone into very exhaustively, and there is no doubt that if the schedule as asked for is put in force a readjustment will be necessary on the part of foreign manufacturers. The subject is one which is concerning all agencies now in France.

French machine-tool makers are complaining against what they consider is the avoidance of the present customs laws, owing to the practice on the part of some importers of taking their machines apart and introducing them in detached pieces. This applies more particularly to the smaller machines, since it is claimed that the importer has no interest in detaching pieces of machines weighing more than 250 kilos, as the duty on machines weighing between 250 and 1,000

kilos is only 16 francs ($3.09), and for those of 1,000 it is only 10 francs ($1.93). It is asserted that in some cases foreign machines are introduced into France when the weights are between 250 and 1,000 kilos in detached pieces, and that the tax of 16 francs is avoided thereby and the duty reduced to 10 francs.

I have not attempted to go into this subject more in extenso, but have outlined enough in this report to indicate the question which is now agitating the machine-tool interests of France in their representations to the French Government.

NO PREJUDICE AGAINST FOREIGN TOOLS.

So far as the writer is able to observe, there is no more prejudice in France against foreign-made machine tools than existed ten or fifteen years ago. In fact, from what can be learned, the prejudice was somewhat stronger a decade and a half ago than to-day. German tools have been imported into France in very considerable quantities during the last three or four years. The writer has heard reference made to opposition among French manufacturers to foreign tools, but he believes this prejudice is largely confined to a few individuals, and particularly to interests connected with the development of the new French machine-tool house located in St. Ouen. The majority of the prominent automobile manufacturers gave little encouragement to the Marquis de Dion, it is said, when he solicited their assistance as stockholders in the new French machine-tool house known as the Société Française des Machines-Outils, and so far as known there are only two or three automobile manufacturers, and those not the most important, who adopted the Marquis's views and joined him in the new French company.

INCREASED DUTIES ADVOCATED.

It is well known that some French manufacturers of small tools, such as milling cutters, twist drills, and taps, have been complaining about the introduction of foreign-made tools, and I understand that the manufacturers of such tools have been advocating the raising of the duty for that class of articles. The opinion expressed to the writer by well-informed men actively engaged in the machine-tool industry here is to the effect that they doubt very much if the French Cabinet will agree, on discussion before the chambers, to a new tariff law, but if this is done, it is believed the change, if made, will not be as radical as requested by the commission of experts of French tool manufacturers.

The best opinions obtainable among Frenchmen who are in a position to speak advisedly regarding machine tools are, in effect, that *the tariff of 1892*, which was passed for the protection of the French

manufacturers, has been entirely satisfactory. It is understood that the machine-tool subject in that tariff was largely at the recommendation and work of the late M. Bariquand, of the French machine-tool house of Bariquand & Marre. This firm enjoyed a world-wide reputation equal to Brown & Sharpe, of America, and superior at that time to Lud. Loewe & Co., of Berlin. Under the new protection Bariquand & Marre, it would seem, have done even less than prior to the tariff. This, at any rate, is the judgment of well-informed French machine-tool men.

SOME EFFECTS OF THE TARIFF LAW.

Similar opinion is expressed concerning the Usines Bouhey. This firm in 1892 was regarded as one of the best designers and builders of heavy machine tools. Still other prominent tool manufacturers at that time, such as Sculfort & Fockedey, Vautier & Co., as well as the smaller firms of Maubeuge, Albert, and Paris, have not, according to these same opinions, benefited by the 1892 law. It is declared that prior to 1892 some of the French tool manufacturers had succeeded in developing their businesses to the extent of establishing a very broad trade in France and in foreign countries, and these same firms have, since 1892, declined rather than advanced.

A marked exception is called to my attention in the case of the machine-tool house of Sarallier & Pradel. Prior to 1892 this firm constituted a small plant, but on passing into the hands of H. Ernault the firm developed a most important and profitable business. The success of Messrs. Ernault may be ascribed directly to the superior technical knowledge and skill evinced by them, and while the 1892 law was of no benefit apparently to those firms which requested it, the same conditions did not prevent a house like H. Ernault, with its highly specialized technical staff, from laying down and developing what is regarded as one of the most profitable businesses in machine tools in France.

The best opinions which the writer can obtain in the machine-tool field here are that if the increased tariff is demanded for the machine-tool industry in France the same arguments will apply just as well for agricultural machinery, sewing machines, typewriters, etc. If the views of the machine-tool men are recognized as views to be commonly accepted, the result will be a general raise all round of the tariff in France, with a resulting protection not at all required. It may be truthfully said that there is no better opportunity in France to-day for the manufacturers of agricultural machinery, sewing machines, typewriters, etc., than for the builders of machine tools. The facts are, it is declared, that in France the means are limited and that skilled labor is lacking.

The experience of Germany in raising its rates of late has not been so satisfactory, it is declared, as to make it advisable for similar measures to be taken in France.

THE AUTOMOBILE WORKS OF A. CLÉMENT, NEAR PARIS.

MACHINE TOOLS IN USE.

The automobile works of A. Clément are located on the Quai Michelet, Levallois. The situation is on the outskirts of Paris. This firm manufactures the machine known as "Bayard," and had June 6, 1908, about 1,100 men on the pay rolls, which force is confined to the Paris shops. An additional 800 men are working in the branch shops in Messières. I was afforded opportunity to inspect the machine-tool installation in the Levallois works, in which were found American machine tools in service from the following firms:

Ohio Machine Tool Company, Kenton, Ohio, lathes; Brown & Sharpe Manufacturing Company, Providence, R. I., full line of tools; Flather & Co. (Incorporated), Nashua, N. H., lathes; Pratt & Whitney, Hartford, Conn., engine and turret lathes and millers; Baker Brothers, Toledo, Ohio, automatic tapping machines; Powell Planer Company, Worcester, Mass., planers; Potter & Johnston Machine Company, Pawtucket, R. I., automatic turret chucking machines; National Separator and Machine Company, Concord, N. H., 4-spindle drill press; Jones & Lamson Machine Company, Springfield, Vt., turret lathes; M. F. Company, Millers Falls, N. Y., saws; J. E. Snyder & Son, Worcester, Mass., drills; Baush Machine Tool Company, Springfield, Mass., multiple spindle drills; Perkins Machine Company, Boston, Mass., hand presses; Fellows Gear Shaper Company, Springfield, Vt., shapers; Gisholt Machine Company, Madison, Wis., turret lathes; Landis Tool Company, Waynesboro, Pa., grinders; Becker-Brainard Milling Machine Company, Hyde Park, Mass., millers; William Sellers & Co., Philadelphia, slotter; Hendey Machine Company, Torrington, Conn., lathes; Warner & Swasey, Cleveland, Ohio, turret lathes; Watson-Stillman Company, New York, hydraulic press; Lapointe Machine Tool Company, Boston, Mass., broaching machines. Many of the chucks in use are from D. E. Whiton Company, New London, Conn., and from the Cushman Chuck Company, Hartford, Conn.

There are at least 30 Flather lathes in service. These tools are well liked. The French automobile shops when installing American lathes usually confined themselves to one make. W. F. and J. Barnes's drills were found doing service boring in connection with jigs. These tools were referred to as doing satisfactory work very cheap. The Ohio Machine Tool Company's tools were turning down four-cylinder crank shafts, and were completing the work at a labor cost of 25 francs per 50-horsepower engine. The Watson-Stillman hydraulic press was referred to as a very good machine.

When asked for a frank criticism of American lathes, the reply was that some of the tools are too light for the new high-speed steels and that they must be made heavier. The opinion was expressed that

the gears on American lathes, as a rule, are too light and too small in diameter, and that the countershafts are very faulty. In many instances the pulleys, it was declared, are too small and have insufficient driving power. There results, in consequence, a necessity for keeping a very tight belt.

Among the foreign tools present, the following were observed:

Boring tools from Ernault, Paris; grinders from Mayer & Schmidt, Offenbach, Germany; grinders from Webster & Bennet, Coventry, England; millers from J. E. Reinecker, Chemnitz; boring tools from Gebrüder Böhringer, Göttingen, Germany; circular milling machines from Lud. Loewe, Berlin, Germany; gear-teeth rounding machines from Lejeune, of Paris; gear cutters from Biernatzki & Co., Chemnitz, Germany; turret lathes from Alfred Herbert (Limited), Coventry, England; millers from Bariquand & Marre, of Paris; grinders from Charles Churchill & Co., of Manchester, England; woodworking machines from Panhard & Levassor, of Paris.

RELATIVE MERITS OF TOOLS.

The Ernault borers are regarded as especially good for aluminum work as called for on automobiles, because of the long bed. The Clément works during the busiest times have employed about 1,400 men in the Paris shops. It will be noted that with 1,100 men now at work the shops are anything but quiet. The total number of machine tools installed on the Clément floors is approximately 900. The firm maintains a special department for tool repairs and for making special tools, such as are demanded by the peculiar character of the work of the shops.

The differential and axle boxes being worked are of French malleable iron. A. Clément criticises the American malleable iron as being rather black and of a character tending to crumble. The malleable iron is adhered to in the construction of these boxes, since aluminum would not be strong enough for the work.

The Fellows gear shapers were referred to as exceedingly good machines for gearing and short work.

THE CLEMENT ENGINE.

The cylinders for the Clément engines are all of French make, I was informed; and, further, that quite a number of them are sent to the United States for working up into American automobiles. Clément bends all his exhaust tubes cold, without any inside strutting. He uses a French machine for this work, the design of Monet & Moine, of Paris. This tool, they said, saves about 200 per cent over hand work. All Clément engines under test are run fifteen hours under the belt and two hours under full load on the dynamo brake. The dynamo-brake machines of Hillairet Huguet, of Paris, are used.

MOTORS FOR MILITARY SERVICE.

This establishment has taken up the work of making gasoline motors for direct connecting to dynamo. Only small installations are manufactured, the powers ranging from 5 horsepower to 30 horsepower. Still another branch of work is the making of engines for dirigible balloons. One engine under construction has four cylinders and is designated for 120 horsepower. Clément has a first-class testing track built within the confines of his works. The roadway consists of concrete to a depth of 1½ feet, covered with a light layer of small granite stone, laid with tar and asphalt mixed, and the whole is covered with asphalt. The track has been in service ten years and is still in splendid condition.

Two automobiles were observed under construction in the Clément shops for military service. Each vehicle will carry two machine guns, mounted one on either side, about midway of the four and a half length of the chassis. When not mounted, the guns will be slung in pouches over the sides of the car. An armed automobile is now in service with the French troops operating in North Africa.

MEN AND WAGES.

The impression which a visitor receives on visiting the Clément works is most favorable. The shop administration is of a high order, and it is apparent that the men in charge of the various departments thoroughly understand their business. There is a good speed maintained on all tools, and the workmanship throughout the plant is of high standard.

Lathe men are paid on an average 80 centimes per hour. The maximum received by lathe men is about 1.20 francs per hour. Payment is by piecework, the men at the milling machines receive on an average between 80 and 85 centimes per hour, and the maximum does not exceed 1.20 francs. The men at the grinders receive on an average 90 centimes per hour, and a maximum of 1.20 francs. The same statement applies to blacksmiths and coppersmiths. The men working at the drills, slotters, and planers average about 80 centimes per hour. The maximum for all three tools is 1.20 francs per hour.

ÉTABLISSEMENTS DE DIETRICH & CIE., STE. LORRAINE DES ANCIENS.

The automobile works known as Ste. Lorraine des Anciens Établissements de Dietrich & Cie de Lunéville, are located at Argenteuil (Seine-et-Oise). These shops can be reached by either train or tram from Paris and from Porte Maillot. By tram the ride from Porte

Maillot requires about one hour. Argenteuil is little more than a hamlet, and but for the advent of the Dietrich establishment would have little importance.

These works stand in the first rank among French establishments in point of shop efficiency. Nowhere in France is a better shop equipment to be seen than here, and in a number of instances the Dietrich shops are getting a higher per cent of work out of the American machine tools than most of the other French shops I have visited. This statement refers only to certain tools, and in particular to the use of some of our automatic machines. The Dietrich establishment is not as large as several other French automobile works, nor as full of orders as some others, but it may truly be said that the workmanship is exceptionally good and must soon earn for the Dietrich works increased patronage.

USE OF MODERN TOOLS.

In general the automobile works of France represent the best installation of modern machine tools. It is for this reason that special reports on the representative automobile plants are believed to be important, both for the purpose of noting the various tools used and the character of work realized. It has been pointed out in previous reports that many of the foreign shops do not fully appreciate the full capabilities of some of our standard tools, and instances might be enumerated where some of our best machines are indifferently worked, largely because the tools are not understood. The pity is that our manufacturers are not able always to spare expert men to follow up installations with personal instruction. I have now in mind three tools of American make installed in one French shop and used practically only when other tools are not available. These three American tools are automatics, and among the best made in the United States, but they are not understood, and the firm does not hesitate to say that it does not like them. Forty-eight hours' work with these tools on the part of a first-class American machinist would, in my opinion, put them in high favor.

AMERICAN AND OTHER FOREIGN TOOLS.

Every opportunity and facility was afforded me at the Dietrich works to make a complete inspection of that plant. There is not an old tool in service at Argenteuil. Practically every machine in the shops is of recent purchase. This is only natural, since the shops have been occupied only during the past nine months. Heretofore the Dietrich works were located at Lunéville. The main building is ideal, both in design and arrangement, and probably there is nothing

finer of its kind in France. The following American machine tools were found in service on the Dietrich floors:

Baker Brothers, Toledo, Ohio, drills; J. E. Snyder & Son, Worcester, Mass., drills; W. F. & J. Barnes Company, Rockford, Ill., drills; Cincinnati Machine Tool Company, Cincinnati, Ohio, drills; Brown & Sharpe Manufacturing Company, Providence, R. I., grinders; Gleason Works, Rochester, N. Y., gear cutters; Gould & Eberhardt, Newark, N. J., millers; the Fellows Gear Shaper Company, Springfield, Vt., gear shapers; Fitchburg Machine Works, Fitchburg, Mass., lathes; Potter & Johnston Machine Company, Pawtucket, R. I., automatic turret chucking and turning machines; Landis Tool Company, Waynesboro, Pa., grinders; Warner & Swasey, Cleveland, Ohio, hexagonal turret lathes; Cincinnati Milling Machine Company, Cincinnati, Ohio, millers.

The following foreign-made machine tools are also used:

H. Ernault, Paris, lathes; J. Parkinson & Son, Shipley, England, vertical millers; Lubin & Weiffenbach, Clichy, France, machines for cutting keyways on big shafts; Webster & Bennett (Limited), Coventry, England, machine for cutting cam on the cam shaft; Habersang & Zinzer, Düsseldorf, Germany, automatic turret machines; "Phoenix," Brussels, Belgium, vertical miller; J. Combes, Paris, special tool for turning crank pins; "Ducommun," Mulhouse, turret lathes. Many of the German tools in service were purchased from A. H. Schütte, of Cologne, and from Glaenzer, Perreaud and Thomme, of Paris.

Practically all the lathes in service, with the exception of the Fitchburg tools, have been supplied by Ernault. As a rule, French automobile houses when buying lathes have confined themselves to one make, and when an American firm has secured an order it has generally been a large one. I found no less than seven Potter & Johnston automatic turret chucking and turning machines in service, and these tools are turning out completed engine pistons from rough castings. The Potter & Johnston tools take the rough castings, center the work from the inside, turn all the face turns, including the flat of the head, cut all oil and ring grooves, and each tool performs the entire operation in twenty-five minutes. In a later report reference will be made to another automobile house, where this same work is being performed on lathes in about three hours' time.

EXPERIENCE WITH CERTAIN TOOLS.

Director Roux, of the Dietrich works, states that he finds no trouble in using grinders on crank shafts. The representation made to the writer at another plant that this practice tends to spring the shafting is not borne out by the experience of Dietrich. The Potter & Johnston machines are also used in turning out complete wheel hubs. The hubs are finished up from the rough casting in one operation. Potter & Johnston tools were declared by Director Roux to be great savers.

Dietrich uses both Gleason and Bilgram tools in turning out cone gears. Director Roux stated that it takes the Dietrich works in practice from three to three and one-half hours for grinding down shaft work, and that the claim that the work can be done in one hour

and twenty minutes is not realized by his shops. He informed me that an American operator, working very hard, did the work in one hour and thirty minutes as a demonstration, but in practice the Dietrich men can not work up to this pace, and the director does not believe that it is a speed which can be maintained.

MERITS OF SOME FOREIGN MACHINES.

The majority of the twist drills in service come from Morse Twist Drill & Machine Co., New Bedford, Mass., the Standard Tool Company, Cleveland, Ohio, and from stock. Among the foreign tools the machine supplied by Lubin & Wieffenbach, of Clichy, France, for cutting keyways on big shafts, is a noteworthy one. This machine has merit and is well spoken of. The Webster & Bennett tool for cutting cams on a cam shaft is referred to in high terms. The tool supplied by J. Combes, of Paris, turns all the crank pins and the inside of the flat surfaces on the crank shafts. The tool revolves around the work and appears to work accurately and quickly. I am informed, however, that this machine requires a lot of adjustments when first received, and that these adjustments will aggregate between 500 and 600 francs. This is the Dietrich experience.

OUTPUT OF AUTOMOBILES.

The Lunéville shops of this company are still turning out automobiles of all descriptions. These works, originally built as forges and foundries, have been specialized in the manufacture of railway cars of all descriptions, and have also taken up as a second branch the building of automobiles. There are at Lunéville, according to the statement of Director Roux, between 1,800 and 2,000 men employed, out of which number a total of between 600 and 700 are engaged in the automobile shops, turning out from 500 to 700 cars a year. Director Roux stated that although the new works at Argenteuil have been built specially for the manufacture of automobiles, the Lunéville branch is still working on the same lines and will probably continue to do so for some time at least. He added that the total capacity of the two works—Lunéville and Argenteuil—will probably reach about 1,000 cars a year.

The Dietrich lathe men receive on an average, working at piecework, from 1 franc to 1 franc 10 centimes per hour. On the same basis the men at the milling machines receive about 90 centimes per hour.

Dietrich is manufacturing automobiles ranging from 14 horsepower to 75 horsepower, with six cylinders. Traffic wagons are also turned out fitted with 25 horsepower engines. The 14 horsepower

engines under electric brake test are turned up to 1,500 revolutions per minute.

On June 10, 1908, the number of men employed in the Argenteuil shops was stated at 350.

THE PANHARD & LEVASSOR WORKS, AT PARIS.

The big automobile works known as "Société Anonyme des Anciens Etablissements, Panhard & Levassor," are located just inside the Paris gates and on June 10 were working about 2,000 men. This is a very fine establishment. The character of the work turned out is of high order, and there is a snap and vim about the place that reflects the greatest credit on the administration.

Panhard & Levassor originally devoted themselves to the manufacture of wood-working machine tools, but with the advent of the automobile industry this firm entered the field for the construction of high-powered autos. The wood-working machine-tool branch of the business is still continued, but the work in that department is largely confined to the manufacture of steel band saws and saw machines for working in wood and metal. These saws were found in many French plants, and they are spoken of in the very highest terms. It was Mr. Périn, founder of Panhard & Levassor, who discovered the efficacy of the directing guide or steadying head, which alone prevents the saw from breaking. Until this idea developed it seemed impossible to utilize steel saws for band work. It is stated that the steadying-head feature was accidentally discovered when Mr. Périn incidentally, one day, held a piece of wood against the back of the saw for the purpose of steadying it. I am informed that many Panhard & Levassor band saws are sent to the United States. The steel used is of French origin.

SUPERIORITY OF AMERICAN TOOLS ADMITTED.

Panhard & Levassor started business about fifty years ago. This accounts, therefore, for the presence of some machine tools of not very recent make, but it is quite safe to say that for so old an establishment there are more modern machine tools to be found on its floors than at any similar plant I have visited in France. Business with this firm is good, and it was possible, therefore, to see the shops working at practically full capacity. Technical Director Mr. Charles de Freminville personally escorted me over the works and afforded me every opportunity to inspect the machine-tool installation. There are two principal works belonging to this firm—one located in Paris and the other in Rheims. In the Paris shops there are 1,025 machine tools in service, of which 700 are of American make. In the Rheims shops there are 718 tools, of which 600 are of

American make. The great majority of the lathes in the Paris shops appear to have come from Prentice Brothers Company and from F. E. Reed Company, both of Worcester, Mass., and from Ernault, of Paris.

Speaking in general terms, Director de Freminville said: "My opinion is that though some European tools are of the highest make the average can not compete with American tools, so far as workmanship is concerned. Owing to certain circumstances each workshop rarely makes a specialty of one type of tool only, as is usual in the United States, and this is a difficulty in carrying out methodical principles for obtaining true and correct lines."

Director de Freminville informed me that the firm would have bought more American tools two years ago had they been available. It was because American machine tools were not available that many German tools were bought. The engines built at this establishment range from 8 horsepower up to 65 horsepower.

AMERICAN MACHINE TOOLS.

The following American machine tools are in service at Panhard & Levassor's:

Cincinnati Milling Machine Company, Cincinnati, Ohio, millers; Mark Flather Planer Company, Nashua, N. H., shapers; Gisholt Machine Company, Madison, Wis., turret lathes; Foote, Burt & Co., Cleveland, Ohio, 4-spindle drills; F. E. Reed Company, Worcester, Mass., lathes; Prentice Brothers Company, Worcester, Mass., lathes; Bullard Machine Tool Company, Bridgeport, Conn., boring mills; Landis Tool Company, Waynesboro, Pa., grinders; Bickford Drill and Tool Company, Cincinnati, Ohio, radial drills; Cincinnati Machine Tool Company, Cincinnati, Ohio, drills; G. A. Gray Company, Cincinnati, Ohio, planers; Warner & Swasey, Cleveland, Ohio, hexagonal turret lathes; W. F. & J. Barnes Company, Rockford, Ill., drills; Niles-Bement-Pond, New York, planer; Brown & Sharpe Manufacturing Company, Providence, R. I., grinders and milling tools; Potter & Johnston Machine Company, Pawtucket, R. I., automatic turret, chucking, and turning machines; Springfield Machine Tool Company, Springfield, Ohio, lathes; Gould & Eberhardt, Newark, N. J., millers. The foreign makers were represented by "Ducommun," J. E. Reinecker, H. Ernault, Biernatski, Bariquand & Marre, Wanderer, Lud. Loewe, and the Leipziger Werkzeugmaschinenfabrik (formerly W. von Pittler).

This establishment possesses quite a large number of automatic tools, but these are at the Rheims works, and are mostly used for roughing purposes. They are used extensively when finishing is obtained by grinding. For instance, Mr. de Freminville said: "When a single tool must finish the work the ordinary lathe is deemed better. Such was the case for small series of pistons entirely machined at Paris works. The large series are made at Rheims by automatic and grinding." On the subject of prices Mr. de Freminville said to me: "So far as the prices of American tools are concerned, they are advantageous between 1,000 kilograms and 2,500 kilograms. Trans-

portation and duties make them rather expensive under 1,000 kilograms and above 2,500 kilograms."

While Panhard & Levassor were busy on June 10, 1908, considerable of the work in hand was for stock in anticipation of a change in conditions in the automobile trade. This firm built the engines for the French dirigible balloon "La Patrie," and Director de Freminville remarked that he saw the balloon passing over their works on its last voyage, little thinking that they were seeing it for the last time. The electric brakes used in many of the automobile shops in France for engine testing are made by Panhard & Levassor and this construction work forms an important branch of the firm's business.

The impression left after a visit to the above firm is a most favorable one. The work is of a progressive character, and there is a high degree of intelligence displayed in the executive departments. No American manufacturer should hesitate to send a representative to a shop of this kind, and if a new tool is offered for sale possessing both merit and capacity its good qualities will be very quickly recognized.

THE DE DION-BOUTON & CIE. WORKS, AT PARIS-PUTEAUX.

FOREIGN TOOLS USED.

The de Dion-Bouton & Cie. works were employing on June 12, 1908, about 2,700 men in all departments. The outputs are confined largely to automobiles, and the engines manufactured comprise from 8 to 30 horsepower machines. The 12, 18, and 30 horsepower engines have 4 cylinders, while the 8 and 9 horsepower have each 1 cylinder. Firms like de Dion-Bouton & Cie. have been heavy purchasers of foreign-made machine tools, and the fact that so much equipment had to be purchased abroad was doubtless the underlying cause for the interest which Marquis de Dion has taken in the new French machine tool house known as "Société Française de Machines-Outils." Marquis de Dion proposed in the course of a speech following a banquet at the automobile exposition in 1906 that his friends unite with him in building in France a special machine-tool works for supplying the automobile industry. The new French machine-tool works known as Société Française de Machines-Outils, described elsewhere, are now engaged in building machine tools for the French trade.

FOREIGN TOOLS IN USE.

The machine-tool installation at the works of de Dion-Bouton & Cie. is a very fine one, especially that part comprising the medium-sized tools which were purchased for the newer shops. Among the American makes of tools in service are the following:

Bullard Machine Tool Company, Bridgeport, Conn., boring mills; Prentice Brothers Company, Worcester, Mass., drills; Gisholt Machine Company, Madi-

son, Wis., turret lathes; Potter & Johnston Machine Company, Pawtucket, R. I., automatic turret chucking and turning machines; H. G. Fish Machine Tool Company, Worcester, Mass., lathes; Hurlbut-Rogers Machine Company, South Sunbury, Mass., cutting-off machines; Pratt & Whitney, Hartford, Conn., turret lathes and cutting-off machines; Brown & Sharpe Manufacturing Company, Providence, R. I., millers and grinders; Landis Tool Company, Waynesboro, Pa., grinders; Fitchburg Machine Works, Fitchburg, Mass., lathes; the Hendey Machine Company, Torrington, Conn., planers; Mark Flather Planer Company, Nashua, N. H., shapers; the Waltham Watch Tool Company, Springfield, Mass., plain milling machine; Kempsmith Manufacturing Company, Milwaukee, Wis., millers; Warner & Swasey, Cleveland, Ohio, hexagonal turret lathes; W. F. & J. Barnes Company, Rockford, Ill., drills; B. F. Barnes Company, Rockford, Ill., drills; Cincinnati Machine Tool Company, Cincinnati, Ohio, drills; Aurora Tool Works, Aurora, Ind., upright drills; Watson-Stillman Company, New York, steam hammer; National-Acme Manufacturing Company, Cleveland, Ohio, multiple spindle automatic screw machines; The Foote-Burt Company, Cleveland, Ohio, reliance bolt cutters and nut tappers; Bickford Drill and Tool Company, Cincinnati, Ohio, drills; Gleason Works, Rochester, N. Y., gear cutters; Hartford Machine Screw Company, Hartford, Conn., screw machines; Draper Machine Tool Company, Worcester, Mass., lathes; Davis & Egan Company, Cincinnati, Ohio, boring mill.

The foreign makers were represented by the following machine-tool houses:

Werkzeugmaschinenfabrik Oerlikon, Zurich, vertical boring mills; Dean, Smith & Grace (Limited), Coventry, England, turret lathes; Alfred Herbert (Limited), Coventry, England, turret lathes; H. Ernault, Paris, lathes; Smith & Coventry, Manchester, England, threaders; J. E. Reinecker, Chemnitz, millers and grinders; P. Huré, Paris, lathes; Fred. Schultz, Mulhouse, lathes; Sächs. Werkzeugmaschinenfabrik, Chemnitz, drills; Wilhelm Kollmann, Barmen, Germany, lathes; G. Birch & Co., Manchester, England, slotters; Aux Forges de Vulcain, St. Denis, France, vertical boring mills; Th. Prieur, Paris, vertical boring mills and slotters; Webster & Bennett, Coventry, England, automatic profile milling machines; J. Parkinson & Son, Shipley, England, plain millers; E. P. H. Bouhey, Paris, millers; Lubin & Weiffenbach, Clichy, France, drills and boring machines; H. W. Ward & Co., Birmingham, England, grinders; "Ducommun," Mulhouse, planer; George Richards & Co., Broadheath, England, lathes; Glaenzer, Perreaud & Thomme, Paris agents, multiple drills of German make supplied in the name of this firm; Leipziger Werkzeugmaschinenfabrik, Leipzig, lathes; Biernatzki & Co., Chemnitz, millers; Luke & Spencer, Manchester, England, grinders.

WAGES—FEMALE OPERATORS.

There are about 40 Draper lathes in service. Lathe hands receive at the de Dion works wages ranging from 85 centimes to 1 franc (19 cents) per hour. This is on engine lathes. On the Alfred Herbert turret lathe the wages run from 85 centimes to 1.25 francs per hour. I counted 12 Bullard boring mills and 9 Potter & Johnston machines at work. The Mark Flather Planer Company has 4 shapers in service, and the Aurora Tool Works the same number of upright drills. Brown & Sharpe have supplied about 11 millers, and I find that de Dion-Bouton & Cie. are employing women operatives with

these machines. One woman was caring for 4 millers and was receiving about 70 centimes per hour. Women operatives were also running gleason gear cutters. One of them had worked at these machines for four years steadily, with the exception of four months' absence as the result of injury. The women operatives are receiving 70 centimes per hour. Seven women were found at work running millers and gear cutters. It is the first time I have found women intrusted with these high-grade machines.

GRADE OF WORK.

The business at the de Dion-Bouton & Cie. works is fairly good, though, in common with other automobile establishments, this firm has been experiencing a considerable falling off in the orders of the last year. The grade of work turned out is of high order, and the equipment is sufficient for an output equal, probably, to that of any other automobile house in France. Practically all the material used in automobile construction is of French origin, and only such foreign tools are purchased as can not readily be obtained in France. In this respect attention is invited to previous reports in which it has been emphasized that the future of the American machine tool in Europe rests largely with the medium-sized machines possessing exceptionally good features. Some of the machines now being turned out by French machine-tool houses possess more than ordinary merit, and it is only natural to expect, in a country where the national spirit is strongly developed, that foreign tools will only be called upon as a last resort. At the de Dion-Bouton & Cie. works there are in all about 1,575 tools in service. The greater part of the American machine tools used were purchased during the past three years.

THE WORKS OF DARRACQ & CIE., AT SURESNES.

Darracq & Cie. on June 13, 1908, were working about 800 men in their shops at Suresnes (Seine). This firm is engaged in the manufacture of automobiles, has at present in hand an order for 400 cabs for service in New York, and has already supplied 300 motor cabs for that city. These New York cabs are supplied with engines of the 4-cylinder, 14 to 16 horsepower type, which this same company is building for service in London and also in Paris. Of the London cabs 600 are of the 2-cylinder, 10 to 12 horsepower type, and in conformity with the London police regulations, no seat is permitted alongside of the driver. This lost space is utilized for luggage. The cabs for New York would cost delivered in Paris about 11,000 francs ($2,123) each. The cabs building for London service cost in Paris about 9,000 francs ($1,737) each. All of these cabs are sold to the Compagnie Commerciale, which in turn sells to New York companies.

During a visit to the Darracq shops I was impressed with the snap and vim in the establishment, and am inclined to think that there is more speed developed in these works than in any of the automobile plants visited. I will not say that the work is better, but do say unhesitatingly that the Darracq & Cie. workmen are pushing the machine tools to a speed approximating fairly close to what Americans are accustomed to see. In consequence Darracq & Cie. are able to estimate very closely on contracts, and this probably accounts for the fact that the establishment is to-day fairly busy with orders.

UNUSUALLY RAPID WORK IN EUROPE.

As an instance of shopwork, the Darracq people are turning down all pistons from the rough castings on Potter & Johnston automatic turret turning and chucking machines. A battery of 29 Potter & Johnston latest-type tools was engaged in this work, and the foreman in charge of the group stated that his men were turning pistons and cutting oil rings in fifteen minutes' time. The cost for turning down one of these pistons, taking everything into consideration, is 30 centimes. The men at the Potter & Johnston tools receive on an average from 1.25 to 1.30 francs per hour (24 or 25 cents), and generally one man works three machines. These wages are exceptionally good for French shops. In a report on another French automobile works, it was mentioned that pistons were being turned down on the above automatic machines in twenty-five minutes' time. It would seem, therefore, that the Darracq men are beating this speed by ten minutes. The statement as to the time in the Darracq works for turning down pistons was made without any information having been given as to the speeds observed elsewhere.

The piston work in the Darracq shops referred to as being performed in fifteen minutes is for engines of 14, 16, and 18 horsepower, and includes the engines for the New York cabs. These pistons have a diameter of 90 millimeters and a depth of 85 millimeters. The automatic machines turn all the face turns, the flat of the head, and cut three oil grooves. One man completes, it was said, about 40 pistons in a working day of ten hours. The total number of automatic machines in the Darracq works, of all makes, is 82.

It costs Darracq & Cie. to finish fly-wheel work for the ordinary sizes 85 centimes each. This cost applies to fly wheels which have an extreme diameter of 400 millimeters and an axle diameter of 100 millimeters. There is a collar around this axle bearing having a diameter of 156 millimeters. The fly-wheel work is handled on Potter & Johnston tools, the work on each wheel being divided between two tools. On a ten-hour per day working basis each workman turns out 15 fly wheels per diem.

AMERICAN AND OTHER FOREIGN TOOLS.

I observe the following makes of American machine tools on the Darracq floors:

Bickford Drill and Tool Company, Cincinnati, Ohio, 12 radial drills; W. F. & J. Barnes Company, Rockford, Ill., drills; Garvin Machine Company, New York, drills; Lapointe Machine Tool Company, Hudson, Mass., reaming machine; Fellows Gearshaper Company, Springfield, Vt., gear shapers; Brown & Sharpe Manufacturing Company, Providence, R. I., shapers; Acme Machinery Company, Cleveland, Ohio, bolt threaders, headers, and nut tappers; Potter & Johnston Machine Company, Pawtucket, R. I., automatic turret chucking and turning machines; Cincinnati Milling Machine Company, Cincinnati, Ohio, millers.

The foreign makers were represented by H. Ernault, Paris, lathes; special Darracq designed machines made in Germany; "Ducommun" Mulhouse, boring machines; J. Combes, Paris, machines for finishing up crank shafts; J. E. Reinecker, Chemnitz, lathes and millers; John Betram & Sons, Dundas, Canada, lathe; Karlsruher Werkzeugmaschinenfabrik, vorm. A. G. Gsokwinot & Co., Karlsruhe, Germany, lathes; J. Dickinson & Co., Keighly, England, drills; Lubin & Weiffenbach, Clichy, France, millers; Preliet, Paris, slotters; Biernatzki & Co., Werkzeugmaschinenfabrik, Chemnitz, vertical millers; Jost & Co., Paris, small vertical drills; Chemnitzer Werkzeugmaschinenfabrik, vorm. John Zimmermann, gear cutters, Leipziger Werkzeugmaschinenfabrik, vorm. W. von Pittler, Leipzig, 10 automatic machines; La Macerienne, Mezieres, France, 30 automatic machines of the Potter & Johnston (American) type; Huré, Paris, small vertical drills; Wanderer, Chemnitz, line of millers; Boehringer Fréres, Coppingen, Germany, planer and lathes; Schubert & Salzer, Chemnitz, drills; Aux Forges Vulcain, Paris, boring machines.

WORK DONE BY VARIOUS TOOLS.

The lathes in the Darracq works are all of foreign make, the majority having come from Ernault and from Darracq designs made in various shops. One Darracq-designed machine was seen which bores all valve seats on an engine job at one time. The Bickford tools are being utilized in boring out engine casings. Another Darracq designed machine bores out the four cylinders at one time. These machines were built in Germany after Darracq patterns. No jigs were observed in use.

The first cuts on shaft work are made on the ordinary lathes and the work is then finished up on the tools furnished by Combes, of Paris. Most of the lathes and boring tools designed by Darracq are of the double type. Reinecker has supplied a line of vertical millers here, and I also found a heavy Reinecker tool designed for rounding teeth edges. "Ducommun" is considerably in evidence, and in addition to the boring machines mentioned in the above list this firm has supplied turret lathes and gear shapers. I counted 14 of these Ducommun gear shapers.

Darracq & Cie. are making 15 types of automobile engines ranging from 7 to 50 horsepower, and which embrace engines of 7, 9, 10, 12,

14, 16, 18, 25, 40, and 50 horsepower. The new cabs which are being built for New York will possess later features than in the first consignment.

From all appearances the Darracq works are at present well stocked up with machine tools, and with the exception of the lathes the installation is, on the whole, quite modern. The turret and hexagonal turret lathe showing is not strong. The shop administration and general executive control of the works is of high order, and this firm can be considered as representing in a high degree the best among modern French industrial plants.

Very recently a new company has been formed, known as Darracq-Serpollet, which was organized with a view of being prepared to undertake heavy orders. This new shop was practically idle in June, 1908, but orders were in prospect which meant the utilizing of at least 200 additional men. In the shops of this new company are 13 Potter & Johnston automatic tools, making a total of 42 of these machines in the two Darracq establishments.

THE BERLIET WORKS, LYONS.

The Berliet Automobile Works, of Lyons, were working on June 24, 1908, about 1,000 men. This is one of the best automobile shops in France. The greater part of the equipment was purchased within the past half decade, and the plant is the exclusive property of Mr. Berliet, by whom it was built and developed through his individual efforts.

During a visit I was afforded every opportunity to inspect both the machine tool installation and the work in progress. All the newer shop buildings have been erected within the past five years. They are beautiful in design and strongly built. The framing and supporting is of steel throughout. Berliet appears to have plenty of work in hand, although the statement was made that the shops were not as busy as in June, 1907. I understand that Berliet has had until now a working agreement with the American Locomotive Company, whereby all Berliet designs were availed of by the American connection. This agreement is now ended, and it is said Berliet will shortly undertake to sell direct in American territory.

Berliet is building motor engines ranging from 14 horsepower up to 80 horsepower, and the types include both 4-cylinder and 6-cylinder machines. Ten hours constitute a working day, the morning period starting at 6 o'clock and ending at 11 o'clock, and the afternoon hours extending from 1 until 6 o'clock.

The drive of this shop appears to be electric throughout, and a high speed is maintained. The yearly output is about 1,200 motor cars. This number is exclusive of traffic wagons, for which a special

factory has been erected. Taken altogether, the Berliet factories at Monplaisir cover an area of 32,000 square meters. The original shop, erected in 1899, covered only 90 square yards.

TYPE OF CHASSIS BUILT.

The chassis built by this concern are of nickel steel, pressed and tempered. The motor is placed in the front part of the chassis and has vertical cylinders, with exhaust and inlet valve interchangeable. In the case of the 60-horsepower 4-cylinder engine the valves are located on top of the cylinders. The crank shaft is rigidly supported on three plain bearings. The half-time wheels, the driving wheels for the pump and magneto, the cam shafts, with cams cut from the solid and ground after hardening, are all inclosed in the crank chamber and lubricated by the splash of the oil. The automatic lubrication, gear driven from the motor, insures a circulation of oil to the different working parts, and the delivery of oil is in proportion to the speed of the motor. All pistons are of steel, with three rings at the upper part and a fourth ring at the lower part, the latter to prevent the oil passing the piston. Ignition is by Simms-Bosch magneto, gear driven.

Berliet uses a carburetor of his own design. This carburetor is fed from a petrol reservoir located at the back of the chassis, and receives the necessary pressure from a portion of the exhaust gases. Cooling is effected by a radiator of the usual honeycomb type. Circulation of water is secured by a rotary pump, and the circulation of air through the tubes is assisted by a belt-driven fan placed immediately behind the radiator. The clutches are of the multiple-disk type, interlaced, some in bronze fixed to the first-motion shaft and others in steel attached to the motor. These clutches are pressed one against the other by a spiral spring. The change-speed gear from the workmanship standpoint is made up of a lot of very finely machined parts. The shaft, for example, between the motor and gear box is provided with a special joint to insure alignment. The fourth speed, as in most types, is a direct drive, and in the 40 and 60 horsepower engines there are direct drives on the third and fourth speeds. Berliet uses for his 14 and 22 horsepower models what he terms a live axle, consisting of two machined-steel forgings rigidly fixed to a central box containing the differential and beveled pinions. To this box is bolted a pressed-steel torque rod, the other end of which is attached to the chassis. The sleeves carry at their extremities strong ball bearings placed exactly in the axes of the wheels and lodged in the hubs, which are driven by the differential shaft through jaw clutches. There is apparent throughout the Berliet shops evidence of very fine machine work, and the tools used are necessarily high grade in manufacture.

AMERICAN AND OTHER FOREIGN TOOLS.

The following makes of American machine tools were observed on the Berliet floors:

Cincinnati Milling Machine Company, Cincinnati, Ohio, millers; Landis Tool Company, Waynesboro, Pa., grinders; Brown & Sharpe Manufacturing Company, Providence, R. I., full line of tools; Washburn Shops, Worcester, Mass., drills; Hulburt-Rogers Machine Company, South Sudbury, Mass., cutting-off machine; Fosdick Machine Tool Company, Cincinnati, Ohio, drills; Whitney Manufacturing Company, Hartford, Conn., grinders; Garvin Machine Company, New York, vertical millers; National Machinery Company, Tiffin, Ohio, chucking machines for bolt making; Pratt & Whitney, Hartford, Conn., turret lathes and grinders; Potter & Johnston Machine Company, Pawtucket, R. I., shapers; Cleveland Automatic Machine Company, Cleveland, Ohio, automatic machines; Gleason Works, Rochester, N. Y., gear cutters; Fellows Gear Shaper Company, Springfield, Vt., gear cutters; Beaudy & Co., Boston, Mass., steam hammer in foundry department; Mitts & Merrall, Saginaw, Mich., drills.

The foreign tool makes were represented in the Berliet shops by the following:

Biernatzki & Co., Chemnitz, gear cutters; H. Ernault, Paris, lathes, gear cutters, and millers; J. E. Reinecker, Chemnitz, drills; J. E. Weisser Sohne, Schwarzwaldenbahn-Baden, multiple drills; H. W. Ward & Co., Birmingham, England, drills and turret lathes; Alfred Herbert, Coventry, England, turret lathes, drills, and millers; Habersang & Zinzen, Düsseldorf, drills; Lomont-Hurtu, Albert (Somme), planer; Société Anonyme Nielsen Winther, Copenhagen, turret lathes of a type similar in appearance to Gisholt; Wanderer Works, Chemnitz, millers and gear cutters; Webster & Bennet, Coventry, England, millers and lathes; Bariquand & Marre, Paris, vertical millers; G. Birge & Co., Manchester, England, drills; Leipziger Werkzeugmaschinenfabrik, vorm. W. v. Pittler, Leipzig, four automatic machines of the Potter & Johnston (American) type; Simplex Engineering Company, Manchester, England, threaders.

MISCELLANEOUS MACHINES.

Beaudy & Co., of Boston, have one hammer of their make in the forge shop. All other hammers are of French make. Alfred Herbert, of Coventry, has a large line of millers installed here, and in this connection it may be remarked that some of the leading French firms have drawn quite liberally on English machine tool makers. The situation in this respect is different from what I have found in Germany, Switzerland, and northern Italy. In Germany an English tool was very rarely found, with the exception of a Herbert lathe and some heavy tools for locomotive work.

Four Pittler automatic turret chucking and turning machines were found at work. The name plate had to be read before becoming convinced that these were not Potter & Johnston machines. The latter firm is represented by shapers, but the Leipzig house secured the order for the automatics. In previous reports reference was made

to the close approximation of Pittler to some of our standard American work. It matters little whether he can be accused of copying or not, the fact remains that it is very difficult to distinguish between a Pittler and a Potter & Johnston tool, and when there is a difference in price the cheaper machine is apt at the outset to have an advantage. This, however, is the first instance in France coming under my personal notice where Pittler tools are used exclusively. The prices of these Pittler machines laid down in Lyons were:

No.	Francs.
AT2 admettant 25 m/m de barre	4,450
AT3 admettant 35 m/m de barre	5,350
AT4 admettant 55 m/m de barre	5,950

NEW MERITORIOUS TOOLS DESIRABLE.

Eight quite new machines very recently purchased from the Simplex Engineering Company, of Manchester, England, were seen here. The tools are of a type similar to those manufactured by the National-Acme Manufacturing Company, Cleveland, Ohio. The Gleason gear cutters are well liked at Berliet's and were referred to as "very clever machines." In all there are over 500 tools installed in the shops, and of this number about 50 per cent are of American origin. The Berliet establishment will soon devote more of its energies to the developing of traffic wagons. It is the writer's opinion that these works, by reason of the high standard of output, will always welcome new tools possessing merit and affording a reduction in cost of labor. The policy here is a progressive one, and the executive management is marked by a high degree of intelligence. The writer has never visited a plant more open to inspection and an exchange of ideas than this one. Berliet is representative of the best in French industrial development of the present day, and because of this fact no manufacturer, I am inclined to think, need hesitate to call to the attention of the Lyons firm a new machine. This establishment is in the market at all times for the best tools obtainable regardless of origin.

THE THOMSON-HOUSTON WORKS, AT PARIS.

The Thomson-Houston electrical establishment was working, May 27, 1908, over 750 persons in its Paris shops. Of this number about 60 were women and girls. One year previous to this the force employed approximated 1,000. This reduction is in keeping with the general state of the electrical trade at present in France. At its branch shops at Neuilly-sur-Marne the firm was employing about 200 persons in the manufacture of small dynamos and motors, both direct and alternating current, up to about 30 horsepower. This firm has another large plant started at Lesquin, near Lille, in the north of France, equipped especially for the manufacture of the Curtis

turbo-generator sets, and all large electrical units. The force employed there was about 100 persons in May, 1908.

I understand that all former holdings of the General Electric Company in France have been acquired by the Thomson-Houston firm, and that a working agreement exists which withdraws the General Electric Company and the Allegemeine Electricitäts Gesellschaft from competition with the Thomson-Houston firm on French territory. At the same time all new designs, plans, and developments are exchanged freely between the three firms above mentioned. The arrangement leaves only French Westinghouse as an American competitor with Thomson-Houston in France.

AMERICAN TOOLS IN USE.

A visit to the Thomson-Houston Paris shops disclosed that practically every form of electric equipment is manufactured. The work turned out is of very high character, and necessitates the use of the most modern and accurate machine tools. I found on the floors machine tools of American, English, German, Austrian, Swiss, and French make, and in one instance a Swedish tool. The American makers were represented by the following firms:

The Fellows Gear Shaper Company, Springfield Vt. (gear shapes); Norton Grinding Company, Worceser, Mass. (grinding machines); F. E. Reed Company, Worcester, Mass. (lathes); Baush Machine Tool Company, Springfield, Mass. (vertical multiple drills); Whitcomb Machine Tool Company, Worcester, Mass. (planers); Bullard Machine Tool Company, Bridgeport, Conn. (boring mills); Springfield Manufacturing Company, Bridgeport, Conn. (grinders); Pratt & Whitney, Hartford, Conn. (lathes and measuring machines); The Whitney Manufacturing Company, Hartford, Conn. (milling machines); Browne & Sharpe Manufacturing Company, Providence, R. I. (turret lathes, grinders, and milling machines); Potter & Johnston Machine Company, Pawtucket, R. I. (automatic turret chucking and turning machines); Niles-Bement-Pond, New York (boring mills); Garven Machine Company, New York (millers); E. W. Bliss Company, Brooklyn (stamp machines); Manning, Maxwell & Moore, New York (lathes, F. E. Reed type); Ferracute Machine Company, Bridgeton, N. J. (stamping machine); Newton Machine Tool Works, Philadelphia, Pa. (portable vertical planers, portable horizontal boring and milling machines, and rotary planers); Meadville Vise Company, Meadville, Pa. (horizontal boring machines for boring out motor tram boxes); Landis Tool Company, Waynesboro, Pa. (grinding machines); Detrick & Harvey Machine Company, Baltimore, Md. (open-side planer); The American Tool Works, Cincinnati, Ohio (planers, millers, and lathes); Davis & Eagan Machine Tool Company, Cincinnati, Ohio (drill presses); Dresses Machine Tool Company, Cincinnati, Ohio (radial drills); G. A. Gray Company, Cincinnati, Ohio (vertical drill presses); J. A. Fay & Co., Cincinnati, Ohio (woodworking machine); Fosdick & Halloway Machine Tool Company, Cincinnati, Ohio (radial drill); The Ingersoll Milling Machine Company, Rockford, Ill (vertical milling and planing machine); Morton Manufacturing Company, Muskegon Heights, Mich. (key-seating machines); Gisholt Machine Company, Madison, Wis. (turret lathes).

FOREIGN TOOLS IN THE THOMSON-HOUSTON WORKS.

The English firms are represented by the following:

Alfred Herbert (Limited), of Coventry (turret lathes); C. Birch & Co., Manchester (slotting machines); Smith & Coventry, Manchester (vertical boring mills); Kendall & Gant (Limited), Manchester (tapping and drill machines); J. Archdale & Co., Birmingham (drill presses); Richards, Broadheath (drill presses).

The French firms are represented by:

H. Ernault, Paris (ordinary and turret lathes); E. & Ph. Bouhey Fils, Paris, (planers and vertical millers); Schulfort & Fogkedey, Paris (shapers); Pinchart-Deny, Paris (stamping press); Pretot, Paris (universal milling machine); Burton Fils, Paris (drill presses); Huré, Paris (milling machines).

The German firms are represented by:

Deutsche-Niles, Werkzeugmaschinenfabrik, Oberschöneweide bei Berlin (lathe and boring mill); Lud, Loewe A. G., Berlin (millers and shapers); J. E. Reinecker, Chemnitz (lathes, gear cutters); L. Schuler, Coppingen (plate-cutting machines); Fred. Schultz, Mulhausen (boring mill); Schuchardt & Schutte, Berlin (radial drill).

Other foreign firms represented were:

Vulcan, of Vienna (lathes and portable vertical slotters): Maschinenfabrik Oerlikon, Zurich (portable horizontal slotter); Aktiebolaget Verktygsmasjnier, Stockholm (revolver lathe); Demoor, Bruxelles (lathes).

VIEWS REGARDING TOOLS IN SERVICE.

The gas furnaces used in the establishment are from the American Gas Furnaces Company, of Elizabeth, N. J. The Potter & Johnston machines are spoken of highly, and the Gisholt lathes are well liked. There is a Landis grinding machine installed in these shops having a length of 3,920 millimeters. I was informed that a Landis 5-meter, long, open-bed machine is installed in the branch shops of this company at Lesquin, near Lille, France. There is a good installation of Bullard machines here, and for the most part they represent the latest designs of that firm. These Bullard machines are highly praised. The latest machine acquired from the Bullard Company was put down on the Thomson-Houston floor, I was informed, for about $3,000. I found about ten machines present from the Ferracute Machine Company.

Practically all the drive in the Thomson-Houston shops is electric. In many cases the tools are independently driven by motors directly attached. I observed a large Curtis turbine in process of construction, the last to be completed in the Thomson-Houston works, by whom the Curtis turbine is being pushed in French territory. Its competitors are the Zoelly, the Parsons, and Rateau. All kinds and capacity of electrical equipment and apparatus are made at the Thomson-Houston works, which are equipped for turning out units

up to 5,000-kilowatt capacity. They manufacture a large part of the telephonic apparatus used by the State, and are introducing on the French railroads an electrically operated switch and signal system. The firm is progressive, and the high character of work carried on will always necessitate a demand here for high-class, accurate machine tools.

EFFICIENCY OF MEN AND TOOLS.

Judging from what was seen at the Thomson-Houston shops, I should say that the French workman is a good man at a machine. These workmen appear to be men of intelligence, and it should not be difficult for an expert demonstrator to secure good results from them. It has been frequently pointed out in these reports that many shops in Europe using American machine tools are not getting more than 65 to 70 per cent of efficiency out of them. This is because the tools are not thoroughly understood. Take the case of the Gisholt lathe, referred to in the report on the shop of Brown, Boveri & Co. Here was a tool that was disliked because it was not understood. An expert man showed the working possibilities of the tool, reduced the working cost on some material from 3 francs per piece to 60 centimes, and put the Gisholt lathe in high favor in that establishment. The Thomson-Houston people were, I understand, the first to introduce the Gisholt lathes in France.

There was little opportunity to judge at the Paris shops of the machine capacity of the workmen, since this plant as a whole is now being run at a moderate speed. But enough of the way the men handled the tools was seen to give a very favorable impression. It is interesting to note that all shafts in these works are ground to a finish.

There is good direction here, as well as engineering ability, and the more progressive and advanced a shop, the better the opportunity to introduce high-grade American machine tools. This last statement should be borne in mind by our manufacturers in considering the European field. Note what tools are installed in the shops. The tool that will reduce cost appeals to the foreigner, and so also does the machine that will produce superior work.

CRITICISM OF CERTAIN TOOLS.

There was criticism of the cast-iron bearings present in the construction of an American machine, the facts of which have been forwarded in a special report. The opinion was expressed that Brown & Sharpe tools in general, the Cincinnati Milling Machine Company millers, Pratt & Whitney lathes, and Bullard boring mills are unexcelled in their classes by European tools.

My attention was called to a lot of malleable-iron gear covers for tram use, which had been ordered from a Buffalo, N. Y., firm. It

would seem as if malleable iron is little understood in Europe. I was informed, however, that Thomson-Houston will probably abandon the use of malleable iron in favor of aluminum. The latter metal is more expensive, but if an aluminum gear box be broken, the metal can be sold for at least 50 per cent of its original value.

WAGES PAID WORKMEN.

The Thomson-Houston works pay their employees, for the most part, by piecework. A working day involves ten hours. Work commences at 7 in the morning and continues until noon, and is resumed at 1.15 p. m., the shops closing at 6.15 p. m. The operator at one of the Niles boring machines is averaging about 1 franc per hour (19.3 cents). At the Bullard boring mills the operators were receiving rates of pay varying from 90 centimes to 1.10 francs per hour. The men at the lathes and millers average between 85 centimes and 1.05 francs per hour. The grinding hands receive, at an average, 85 centimes per hour. Women receive for hand work between 40 and 50 centimes per hour (100 centimes=1 franc=19.3 cents).

VACUUM PUMPS.

SYSTEM FOR TOPEDO-BOAT INSTALLATION.

The French Government is taking up the Leblanc system of vacuum pumps for torpedo-boat installation. These pumps are very compact, as I am able to attest from observation of two installations. The idea has been developed through the utilization of a turbine wheel, with provision made in the casing of the wheel for connecting an air-suction pipe. Water is taken in at the center of the wheel and ejected at a high velocity by means of a reversed turbine wheel. This water diffuses into spray as it leaves the wheel and traps the air. In passing through the ejector the velocity energy of the water is transformed to pressure energy, thus enabling the pump to discharge against the atmospheric pressure. The quantity of water required for this purpose is not only small, but can be used over and over again. For land installations this is an important factor. The pump, being of a rotary type, can be run at very high speed, making it specially suitable for driving direct. Very little space is required for the pump and practically no foundation. As it is valveless and has no waste spaces its efficiency is extremely high. For connection to a surface condenser a pump of the centrifugal or turbine type is necessary for extracting the condensed water. The pump, however, is being used largely with surface condensers. I learned that in one case an old-style pump in a surface-condensing plant was replaced by one of these Leblanc pumps and the vacuum was increased from 25.6 inches to 27.2 inches, the conditions being exactly the same, but

with an expenditure of only half the power. In another case the vacuum of 19.5 inches with a wet reciprocating air pump was increased to 24 inches on substituting a Leblanc dry rotative vacuum pump.

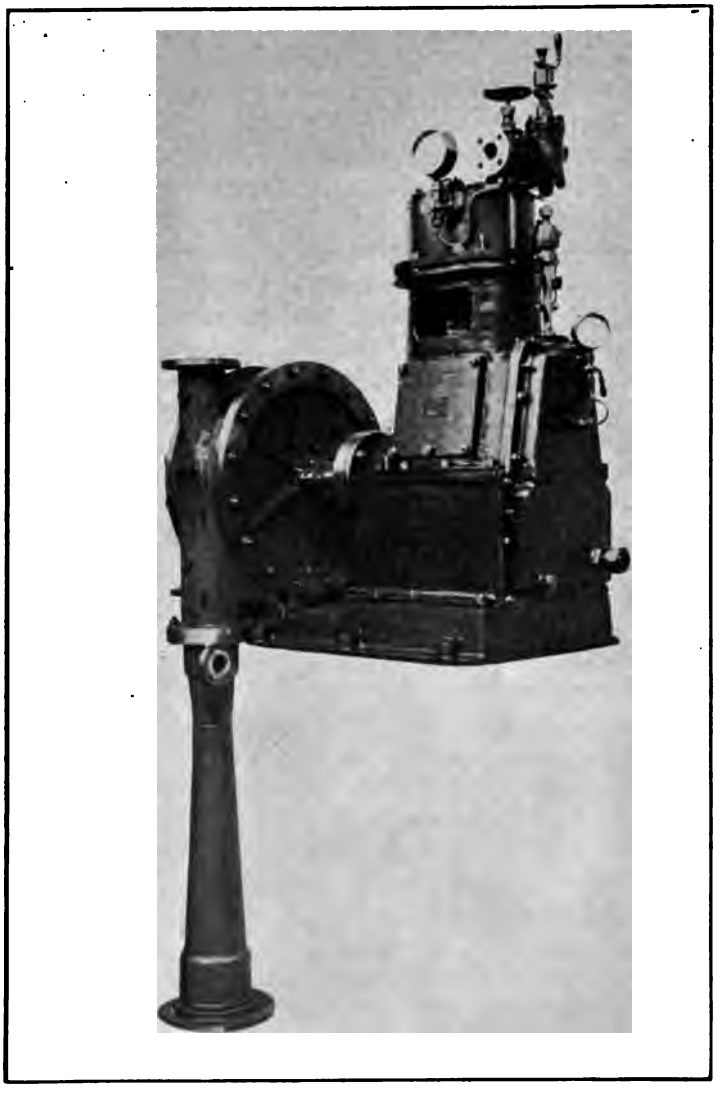

FIG. 17.—Leblanc dry vacuum pump.

THE HOTCHKISS WORKS, ST. DENIS.

The Hotchkiss works, located in St. Denis (Seine), were working on May 29, 1908, 550 men. At this time, the year before, when business was in better condition, about 1,000 men were employed.

While essentially French in its organization, the Hotchkiss establishment has long been recognized as American in direction and control. A story which has been current for many years attributes the founding of the Hotchkiss works in France to a lack of encouragement on the part of the United States. The real facts of the case are as follows:

During the civil war Mr. B. B. Hotchkiss had been supplying a good deal of war material to the United States, more especially the well-known Hotchkiss projectile for muzzle-loading rifle guns. At the end of the war Mr. Hotchkiss was one of the few contractors who realized that there would be a long period during which the policy of the Government would be retrenchment and that he should seek other fields for his activity. Metallic ammunition for small arms having been successfully developed at the Frankford (Pennsylvania) Arsenal, and the use and manufacture of such ammunition being practically unknown in Europe, he decided, in 1868, to go to Vienna, as the Austrian Government had begun to take interest in this subject. There he established a small factory for the manufacture of small-arms ammunition which was fairly successful.

REVOLVING AND RAPID-FIRE GUNS.

It was while in Vienna in 1870 that Hotchkiss conceived the idea of the revolving cannon, which was designed under his direction by A. C. Koerner, still a director of the Hotchkiss Company. During the Franco-German war the committee on the national defense, hearing of Hotchkiss's small-arms ammunition factory, invited him to bring his plant to France, which he did, installing it at Viviers. He received large contracts at the time and was supplied by the Government with a certain number of workmen and an old locomotive, which was put in on skids and used as motive power for his factory. At the end of the war the French Government paid Hotchkiss a considerable indemnity to cancel his contracts, and he removed to Paris, where he took up the development of the revolving cannon. It is an interesting fact that the first revolving cannon for field service was taken up by the United States Government.

When, in the early eighties, Mr. Hotchkiss conceived and developed, in association with Mr. Koerner, the idea of the rapid-fire gun, to which he applied the well-known principle of a nonrecoil gun trained from the shoulder, the United States Government gave him his first order, and the rapid-fire guns for the United States steamships *Atlanta*, *Boston*, *Chicago*, and *Dolphin* were the first of this make, according to the statement of the Hotchkiss Company, which were ordered by any government for actual service. Mr. Hotchkiss died in February, 1885, and soon after his death the present company

was formed in order to take over the business and buy out his installation.

From the foregoing it will be seen that Hotchkiss, far from being discouraged by the United States Government, came abroad in order to find fresh fields for his activities, and that he was always encouraged, although established abroad, through orders for both the army and the navy of the United States. It may be remarked in this connection that up to the present day no artillery business has been developed in the United States which has been able to obtain a foothold in foreign countries. This is largely due to the apathy of the American establishments. On the other hand, American manufacturers of small arms have, at least in the past, been very successful, due to the fact that they have carried on an energetic campaign in foreign countries through American agents sent abroad.

PRESENCE OF AMERICAN TOOLS.

The Hotchkiss works, in common with many other French plants, undertook during the past five years the construction of automobiles; and while this part of the business has suffered by reason of the general depression in the automobile trade of late, the general activity of the shops has been maintained through gun and projectile orders.

Through the courtesy of President Laurence V. Bénet, of the American Chamber of Commerce of Paris, and who is also the head of the Hotchkiss works, I was afforded every opportunity to inspect the shops. I found American tools in service from the following firms:

Pratt & Whitney, Hartford, Conn. (lathes, rifling and gun-barrel boring machines); Lodge & Shipley Machine Tool Company, Cincinnati, Ohio (engine lathes); Warner & Swasey, Cleveland, Ohio (vertical turret lathes); Brown & Sharpe Manufacturing Company, Providence, R. I. (full line of tools); Binsse Machine Tool Company, Newark, N. J. (horizontal borers); F. E. Reed Company, Worcester, Mass. (lathes); American Tool Works Company, Cincinnati, Ohio (lathes); Niles-Bement-Pond, New York (lathes); Hendey-Norton Machine Tool Company, Torrington, Conn. (lathes); The Fosdick Machine Tool Company, Cincinnati, Ohio (drill presses); William E. Gang & Co., Cincinnati, Ohio (vertical drill presses); Putnam Machine Tool Company, Fitchburg, Mass. (drills); Becker-Brainard Milling Machine Company, Hyde Park, Mass. (millers); Potter & Johnston Machine Company, Pawtucket, R. I. (automatic turret chucking and turning machines and shapers); Baker Brothers, Toledo, Ohio (keyway slotters); Springfield Machine Tool Company, Springfield, Ohio (shapers); Bickford Drill and Machine Tool Company, Cincinnati, Ohio (radial drills); Norton Grinding Company, Worcester, Mass. (grinders); Jones & Lamson Machine Company, Springfield, Vt. (turret lathes); Davis & Egan Machine Tool Company, Cincinnati, Ohio (lathes); Fellows Gear Shaper Company, Springfield, Vt. (gear shapers); W. F. & J. Barnes Company, Rockford, Ill. (drills); Landis Tool Company, Waynesboro, Pa. (grinders).

FOREIGN TOOLS.

The following tools of foreign make were in service in the Hotchkiss shops:

P. Huré, Paris (lathes); H. Ernault, Paris (boring mills and lathes); "Phœnix," Ghent (double vertical lathes); Union-Diehl, Chemnitz (horizontal boring machine); Boehringer Fréres, Coeppingen (boring tools); Lud. Loewe A. G., Berlin (milling and gun-barrel drilling machines and gear-testing machine); J. E. Reinecker, Chemnitz (vertical millers); Bariquand & Marre, Paris (milling machines); Taylor & Hobson, Leicester, England (engraving machine); Alfred Herbert (Limited), Coventry, England (turret lathes); Richards & Co., Broadheath, England (keyway miller); Bilgram gear shapers of American design furnished by J. E. Reinecker, Chemnitz.

STANDARD GAGES—LATHES AND PROJECTILES.

Certain standard gages used have been supplied by C. E. Johansson, of Eskesstuna, Sweden. The Johansson gages are regarded by many as unsurpassed in accuracy. The writer has talked personally with gage makers, who have not hesitated to express admiration of the work turned out by Johansson; and the interesting part of it is that no one has been able to discover how Johansson makes his gages. Johansson declares that he has his own machines, designed by himself, and this is doubtless true. At the Hotchkiss shops was a box of Johansson gages which were purchased for about $250. The statement was made that the gage proved true and that on the assembling of the smaller gages the additions came out absolutely correct with the single gages, which stood for the several additions. Great care has to be exercised in handling these gages to assure that they are not affected by temperature, expansions and contractions.

I observed 45 Huré lathes at work in one department turning out small-caliber, rapid-fire gun projectiles. The lathes were designed by the Hotchkiss Company, and I understand that the Hotchkiss management prefers that there shall be a flow of projectiles from lathe to lathe rather than an attempt to work up the projectiles on turret lathes. I inquired why turret lathes were not used for this sort of work, and received a reply to the above effect. It can not be said that these Huré lathes are doing slow work. They are working up hard steel in these projectiles, and I am informed that these 45 tools turned out for the Russian Government 4,000 projectiles a week of 6-pounder type, working seven days a week, twenty-two hours per day. I observed, however, in this connection that the majority of these Huré lathes are in reality double machines. The 45 tools are being operated by about 15 men; the projectiles are turned up from chrome steel.

The Lodge & Shipley Machine Tool Company, of Cincinnati, have fully 16 engine lathes in the Hotchkiss shops. The tools are well liked. I understand that the machines which "Phoenix" of Ghent

sold the Hotchkiss company were made in Sweden. One of these Phoenix machines is a double vertical lathe and is well spoken of. In fact, I was informed that some work can be gotten out with this tool to better advantage than with some of our American tools, due to the large angles to which the head may be set.

The Ernault boring tools in service in the Hotchkiss shops have been adapted for boring four cylinders at one operation. The German tool made by Boehringer Frères, which is in service on the Hotchkiss floors, was furnished by Glenzer & Perreaud, of Paris. This firm of agents is also handling American tools. In previous reports reference has been made to the fact of agents representing firms of different nations.

HIGH MERIT OF AMERICAN LATHES.

It is not uncommon now to find agents pushing special tools of their own design, and these designs, it must be understood, have been prepared with what the agent pleases to call his special knowledge of the demands of the trade. My attention has been called to one agency which orders tools made in Germany, the tools in question being in reality American tools with, for example, a special tool post, and perhaps a little broader saddle and a few other special features which the agent knows appeal to the European trade. The American Tool Works Company, of Cincinnati, has more than 50 lathes in service on the Hotchkiss floors. There is no question as to the high merit of the lathes of this firm, and yet I am informed that the Hotchkiss people found it necessary to change the tool posts on every one of these lathes. The change was made because the tool posts sent from Cincinnati were not suited to the French needs. One of the old tool posts was taken out of a chest for my inspection and held up to view, with a smile from the French mechanic and a remark that it could not be used. These are facts that are well known to many of our lathe makers. I pointed out that lathes now coming from Cincinnati are being built with a special view to European requirements. There was some criticism expressed in the Hotchkiss shops that the saddles on many of our lathes are not broad enough to permit working with the tool parallel to the bed. Still another criticism was the failure of some of our manufacturers to indicate all measurements in millimeters. It was said that the instructions stamped on the machines with reference to oiling and functioning should be in French and not in English.

AMERICAN AND GERMAN TOOLS.

I found a Lud. Loewe gun barrel double-spindle drilling machine at work alongside of several Pratt & Whitney machines, and was told

that Pratt & Whitney might have had this order; in fact, that Hotchkiss did not care to take chances with a Lud. Loewe tool with which they were not acquainted. The German tool, however, had very agreeably disappointed them, as it was doing excellent work. I was informed that the workmen in the Hotchkiss shops broke every reversing lever in the saddles on the lathes furnished by the American Tool Works Company, of Cincinnati, because these reversing levers were made of cast iron. The Hotchkiss company put on new forged steel levers. Aside from this the lathes furnished by this company are in high favor. On the subject of the tool posts above referred to, the claim is made at the Hotchkiss shops that the American type of tool posts for lathes is not adapted to heavy duty service. These observations will indicate to our manufacturers the view point of the foreign machinery men.

The opinion was expressed at the Hotchkiss works that there is not a good line of vertical millers offered on the continent by American firms, and that, in consequence, shops like Reinecker, of Chemnitz, and Bariquand & Marre, of Paris, are getting the most of the business. Reinecker, it is declared, is offering the best line of vertical millers obtainable over here. Such vertical millers as have been offered by American firms are not regarded as suited for heavy service work.

The Hotchkiss people had drilled through the main bearing on a miller made by an American firm in order to get an oil line on bearings which, in the opinion of the Hotchkiss officials, demanded more lubrication. New oil cups and micrometer stops were furnished by the Hotchkiss works to other millers of the same firm in addition to the oiling arrangements, and the criticism was made that these were essential details which should have been furnished. The millers referred to are liked and spoken of as first-class tools.

The engraving machine furnished by Taylor & Hobson, of Leicester, England, is a most interesting and ingenious tool, and, so far as the writer knows, it is the only one of its kind in the world. The Hotchkiss works do practically all their plate engraving with this machine.

The Bilgram gear shapers supplied by Reinecker are referred to as most accurate machines. Not only at the Hotchkiss works, but elsewhere in Europe the writer has heard the opinion expressed in well-informed machinery circles that the Bilgram tool which Reinecker secured from America constitutes one of the best outputs of the Reinecker shops.

The Hotchkiss works are appreciating the value of grinding machines, and I am informed that for the Russians more than 90,000 shrapnel were turned out on the grinding machines now in the shops.

OPPOSITION TO AMERICAN TOOLS OVERCOME.

The Jones & Lamson turret lathes installed are the earlier type of that company. I was informed that the Hotchkiss Company had discharged six men, one after the other, before they could induce the shop hands to work with these Jones & Lamson tools when first introduced. The men, it was said, did not like the machines, and considered it beneath their dignity to work at tools which left practically nothing for the tool hand to do. However, the disciplinary measures occasioned by the discharge of six men brought some of the rest of the hands to their senses, and it was not long before the shop force wondered what it was that they originally disliked about the Jones & Lamson tool.

As the writer has pointed out repeatedly, new American machines do not jump into immediate favor in Europe. A good demonstrator is half the battle in pushing a new tool abroad. The success in Europe of several of our American firms has been due, in a great measure, to sending some first-class mechanics abroad to work in connection with the agencies. The Hotchkiss works are now running 12 Jones & Lamson turret lathes. The idea of buying a Jones & Lamson machine first occurred to one of the Hotchkiss officials on seeing a Jones & Lamson turret lathe at work in the Washington Gun Foundry. Here is another instance of where one of our tools sold itself through merit. The wonder is how much more could have been done through organized efforts, and by this I mean the opposite of an occasional agency here and there. The spectacle is presented to-day in Europe of American machine tools being sold by foreigners in countries in which they are in many cases foreigners. There may be good reasons why a Frenchman is better adapted than an American to sell American machine tools in France, but this does not extend to Germans, Swiss, or other nationalities operating outside of their own countries.

I estimate that there are more than 350 machine tools in the Hotchkiss shops, and I am reliably informed that there are 138 lathes in all. All chucks and twist drills used by the Hotchkiss establishment are purchased in the United States. The Hotchkiss shops are working 22 apprentices, the sons, for the most part, of workmen. According to French law, apprentices are not permitted to work in shops where adults are employed for more than ten hours a day. In order, therefore, to comply with the law, the apprentices are locked off in a screened apartment.

OUTPUT OF AUTOMOBILES.

The work turned out by the Hotchkiss works at present is confined to automobiles, rapid-fire and machine guns, and 3, 6, 9, and 14 pounder rapid-fire gun projectiles. The automobiles manufactured

comprise various powers up to 130 horsepower. All metal for these machines is received from French sources. In general the gear boxes are made of aluminum. The tendency now is to cut out all guns below 3-inch caliber. The Hotchkiss works are exploiting a new machine gun having a weight of about 22 pounds, and designed to be carried on the shoulder. This weapon is now under consideration by the Ordnance Bureau of the United States War Department.

The Hotchkiss works did not hesitate to cut a lathe in two in order to adapt it for some special caliber guns ordered by Russia in connection with war orders. It was found that when the Russian order came that the boring tools installed were not long enough, and some of the French machinists were in despair until Director Bénét, with American resourcefulness, directed that certain lathes be cut in two and the headstock shifted until there was a sufficient length of swing obtainable. These sawed-across lathes have been doing service ever since, and have yielded most satisfactory results.

CLASSIFICATION OF WAGES.

The Hotchkiss works are paying wages as indicated in the following table, the figures representing the mean average per hour for the first month in 1907 and that of the twenty-sixth pay roll, the last one of that year (100 centimes=1 franc=19.3 cents):

Kind of work.	First month, 1907.	Twenty-sixth pay roll.	Kind of work.	First month, 1907.	Twenty-sixth pay roll.
	Centimes.	*Centimes.*		*Centimes.*	*Centimes.*
Vise and assembling men	0.737	0.754	Machine men	0.503	0.552
Tool makers	.828	.805	Lathe hands	.773	.721
Turret machines	.613	.612	Shop laborers	.503	.548
Millers	.728	.724	Smiths	.848	.773
Slotters, Planers, Drillers	.660	.662	Strikers	.520	.527
			Coppersmiths	.697	.671

The company is paying at the end of each year to those men who have been in its employ between twenty-five and thirty years 8 per cent of their day wages for the year. For the year 1907 there were 24 workmen in this class. The largest amount paid was 262.25 francs and the lowest 105 francs. There were 15 men who had served between twenty and twenty-five years. These men receive 7 per cent on their day wages. For the year 1907 the highest amount paid in this class was 203.85 francs and the lowest 85 francs. Six men qualified in the class of fifteen to twenty years' service. These men receive 6 per cent on their daily wages. The highest amount paid in 1907 in this class was 150.35 francs and the lowest 93.30 francs. Twenty-one men qualified in the class having between ten and fifteen years' service. These men received 5 per cent on their day wages.

For the year 1907 the highest amount paid in this class was 175.30 francs and the lowest 68.30 francs.

Thirty-seven men qualified in the class having a period of service of between five and ten years. These received 4 per cent on their day wages. The highest amount paid in this class was 132.50 francs and the lowest 52.90 francs. The total amount paid out by the company in premiums for the year 1907 amounted to 13,234 francs. This sum of money was divided between 93 men in the proportions above enumerated. Under this premium system the Hotchkiss Company is able to count on the constancy of a goodly proportion of its men. As a prerequisite it is necessary that a man serve continuously, and any participation in a strike necessarily deprives the man of premium money.

THE WORKS OF SCHNEIDER & CIE., AT LE CREUSOT.

Le Creusot is to France what Essen is to Germany. In the latter place Krupp holds sway. At Le Creusot it is Schneider & Cie. The total number of men carried on the pay rolls of Schneider & Cie., June 23, 1908, approximated 20,000. Of this number, 12,000 were in the Le Creusot shops. The remaining 8,000 were scattered among the subsidiary plants at Chalon-sur-Saone, Le Hâvre, Champagne-sur-Seine, Decize, Espagne, Mazenay, Creot et Change, Montchannin et Longpendu, and Perreuil. The shops at Le Creusot cover 2,400 acres. Fancy a small pocket in a low range of hills, jammed with furnaces and machine shops, with a line of railroad winding in and out to the plains beyond, with houses and streets stretching up the hillsides and struggling to reach above the line of smoke, and one sees Le Creusot. It recalls the Allegheny country, the landscape, the industries, and all the accompaniments of a great steel and iron section being similar to the Pittsburg region. It may be said that from Le Creusot to St. Etienne iron and steel are the great products. The industries of this great Le Creusot-St. Etienne district are, next to the steel interests in the east of France, the most important in the iron and steel line in all France. The Creusot works are not a machine-tool house, but it is felt that no report on French industrials would be complete without reference to them, and I am indebted to Messrs. Schneider & Cie. for courtesies and attention afforded.

ORIGIN AND DEVELOPMENT OF THE WORKS.

An English engineer originally founded the Creusot works in 1782, and Louis XVI was interested in the plant. It was known then as the "Royal Foundry." From 1793 to 1814 Le Creusot was utilized almost wholly for the manufacture of cannon. In 1826 the plant

was sold to an English company known as "Société Manby-Wilson et Cie." In 1828 there was formed a new company known as "Société Anonyme des Mines, Forges et Fonderies du Creusot et de Charenton." From these numerous changes it may be gathered that business conditions in France following the Napoleonic era were not the best. In 1836 J. Eugene Schneider and his brother Adolphe purchased the Creusot works and two years later they built the first locomotive constructed in France. Eugene Schneider may really be called the founder of the present establishment. From all accounts he was a wonderful man intellectually and in his ability to control men. Later in years he was president of the French legislature, and lived a most active and eventful life until almost the year of his death, which occurred in 1875. Henri Schneider, son of the founder, became associated with his father in 1867, and later took over the active control of the plant. During his lifetime many of the most important of Le Creusot developments were inaugurated. Like his father, Henri Schneider took an active part in politics, and was a member of the Chamber of Deputies. His death occurred in 1898. The present head of the works is Eugene Schneider, son of Henri Schneider, and grandson of the founder. He has been actively identified with the administration of Le Creusot affairs since 1896.

Schneider & Cie. own about 1,400 workmen's houses, with gardens attached. Liberal provision is made by the company in the way of annual pensions and endowment funds for services. A staff of eight doctors is maintained, and there is a hospital which has cost 2,000,000 francs ($386,000). Schneider & Cie. pay about 2,500,000 francs annually in the interest of the workmen. The administration of affairs is divided between Paris and the foundry offices.

VARIETY OF THE OUTPUT.

Le Creusot first came into existence as a mining locality, and a mine is still worked within the Schneider property here, but it only produces now about 50,000 tons of coal per year, whereas the Schneider works require about 600,000 tons yearly. In consequence additional coal is drawn from the company's collieries at Decize and Montchanin. These two collieries supply about 200,000 tons of coal. Originally started as a foundry, Le Creusot has developed until today there is an annual output of 140,000 tons of pig iron, 155,000 tons of Martin and Bessemer steel, 150,000 tons of finished laminated steel and iron, the various outputs comprising iron and steel billets, puddled iron rails and various railway materials, steel-construction work, ship and boiler plate sheets, locomotives at the rate of five per month, artillery of all calibers at Creusot and Le Hâvre, armor plate at the rate of about 5,000 tons per year, equipments for ship batteries, electrical materials at Champagne, steam engines, turbines

of the Zoelly type and gas engines, railway wheels and axles, castings of all sizes, and at the Chalon-sur-Saone plant torpedo boats are built. It was at this last plant that the material was turned out for the beautiful Alexander III bridge, of Paris, and the bridges over the Rhone and Danube bearing this company's name. Bridges have been sent out from Chalon-sur-Saone to Chile, Tonkin, and other far away parts of the world. Le Creusot has undertaken important harbor works, such as those at Lisbon, Rosano, Le Hâvre, and other places. Automobile chassis are built at Le Hâvre works. As an instance of a new product of manufacture undertaken by Le Creusot, mention should be made of manganese steel castings and manganese steel rails.

CONSTRUCTION OF LOCOMOTIVES—TOOLS USED.

At Le Creusot it was my good fortune to meet Mr. Rais, the commerical manager, and Mr. Panier, the chief of the artillery commercial department, and from these gentlemen every facility to inspect the works was afforded. The locomotive shops were very busy, and it is my understanding that the reason for so many French locomotive orders going abroad during the past year is due to the inability of the home shops to meet the demand. In the locomotive department the American machine tools are comprised of the following: One Niles turning and boring mill, 1 Fosdick radial drill, 2 Brown & Sharpe tools, 1 Gisholt turret lathe, and 2 Bullard tools. The foreign makers were represented by the following: Fetu-Defize, Liege, horizontal borers; Ducommun, Mulhouse, drills and turret lathes; Longdoz, Liege, planers and drills; Ateliers Demoor, Brussels, lathes; Bouhey, Paris, lathes and milling machines; Smith & Coventry, Manchester, wheel lathes and shapers; Duval-Pichet, Paris, milling machines.

Although there are some milling machines in this department, I observed relatively very little milling work here. In the shaft department were found heavy boring tools from J. Whitworth & Co., Manchester, England. All these were motor driven. Thomas Shanks & Co., also an English firm, were represented in this department by turning and boring mills. It was seen that Bouhey, Paris, had supplied a very large turning and boring mill. Ducommun was represented here, as were also Elwell & Seyrig, of Paris. In the boiler department all plate-drilling work was being performed with Bouhey and Ducommun machines. The drilling on all boiler heads was being done with jigs using multiple drills. In the marine department heavy Ducommun and Société Alsacienne tools were being used for planing. Schneider & Cie. have themselves manufactured a number of very heavy tools for use on turbine and ship-engine work, among others a boring mill of 10 meters diameter, weighing 70 tons.

In the marine department American machine tools are in service from the Gleason works, Rochester, N. Y.; Bullard Machine Tool Company, Bridgeport, Conn.; Baush Machine Tool Company, Springfield, Mass.; Brown & Sharpe Manufacturing Company, Providence, R. I.; and the National-Acme Manufacturing Company, Cleveland, Ohio. The engines for the new French war ship *Edgar Quinet* are building at Le Creusot, comprising three engines of 12,000 horsepower each. One of these was practically complete on June 23, when I visited the works. Some of the casting work in Le Creusot shops is as fine as any I have seen in Europe. This is a branch of business in which Schneider & Cie. can well lay claim to the highest merit.

Le Creusot, I was informed, has enough work ahead in some departments to last two years, and it may be assumed that this has largely to do with the artillery and locomotive orders. This view has been confirmed on further reference to Messrs. Schneider & Cie. In the field-gun department American tools come somewhat more into evidence, but I am compelled to say that our American tools are not represented in this great plant to the extent which one would expect to find.

AMERICAN AND OTHER FOREIGN TOOLS.

The American tools found in service, in addition to those previously mentioned in other departments, comprise the following:

Brown & Sharpe Manufacturing Company, Providence, R. I., vertical millers; Pratt & Whitney, Hartford, Conn., lathes; Norton Grinding Company, Worcester, Mass., grinders; Fosdick Machine Tool Company, Cincinnati, Ohio, boring machines; Niles Tool Works, Hamilton, Ohio, planers and drills; W. F. & J. Barnes Company, Rockford, Ill., drills; Hendy Machine Company, Torrington, Conn., shapers; Defiance Machine Works, Defiance, Ohio, planers; Gisholt Machine Company, Madison, Wis., five turret lathes; Potter & Johnston Machine Company, Pawtucket, R. I., automatic turret, chucking and turning machines to the number of about 20; National-Acme Manufacturing Company, Cleveland, Ohio, automatics.

The foreign makers in the gun department were represented by the following:

John Lang & Sons, Johnstone, Scotland, borers; Bariquand & Marre, Paris, millers; H. Ernault, Paris, vertical millers; Bouhey, Paris, horizontal borers, vertical drills, and slotters; J. E. Reinecker, Chemnitz, vertical millers; George Richards & Co., Broadheath, England, horizontal borers; Schultz, Mulhouse, shapers; "Grafenstaden," lathes; Wanderer Works, Chemnitz, millers.

I was informed that there would soon be installed in this department an Armstrong tool of 220 tons weight, capable of swinging a length of 17.53 meters and a diameter of 2.3 meters. This tool will be a turning and boring lathe for heavy ordnance work.

With the exception of a Pratt & Whitney lathe practically all the lathes in this principal machine-tool department are from either

Ernault or Grafenstaden. The shops popularly referred to as "Grafenstaden" are a branch of the works known as "Société Alsacienne de Constructions Mécaniques," Mulhouse. This firm was originally French, that is, until 1870. One branch of the establishment is located in Belfort, French territory, and although the parent house is now in Germany, I am inclined to think that many houses still look upon the Mulhouse shops as French.

In the locomotive department I did not observe any oxygen gas cutting appliances or presses for stamping out plates. All plate cutting was done by punching. Only plate-frame form of construction on locomotives was in progress. The finish on these French locomotives is of high order.

A WELL-EQUIPPED PLANT.

In the armor-plate department some big planers from Ernst Schiess, of Düsseldorf, were observed. There were four in all, and they constitute a handsome installation. In 1900 there was a heavy strike at the Schneider works, and in all about 10,000 men walked out. The strike, which continued about a month, came without warning of any kind and apparently without reason. It seems to have been dictated through a general sympathy with a movement of unrest which existed that year. It will be recalled that in 1900 the Socialists were especially active.

Le Creusot impresses one as being an extraordinarily fine plant. The steel made there is largely on the Martin's process. Ore comes from the company's mines in eastern France, from Algiers, and from Spain. The richest minerals come from the Pyrenees. While Le Creusot is almost in the east center of France it is accessible by canal, both from the Mediterranean and from the English Channel. Torpedo boats and destroyers have been built at the Schneider works at Chalon-sur-Soane and conveyed thence to the Mediterranean.

As heretofore remarked, American machine tools are not much in evidence at Le Creusot, and it would seem that the question of price has cut some figure, for my attention has been called to the freight rates, agent's fees, and duties imposed. This is a matter calling for some attention, as foreign-made tools can often be undersold to advantage by American makes. The best single installation here is, I think, from Schiess. These are machines for armor-plate work and probably constitute the same aggregation which an American firm negotiated for.

It is impossible to exaggerate the importance of Le Creusot, for this is certainly the most important plant of its kind in all France. The highest intelligence marks the direction of the various departments, and taken all in all the establishment is one of which Frenchmen are rightly proud. There is no work here in armor plate or

castings of any kind too large for Le Creusot to handle, and from the standpoint of the gigantic, the Creusot shops can produce sizes the equal of any other plant known to the writer in Europe.

Le Creusot is working on a ten-hour schedule, commencing at 6.30 a. m. and continuing until 11.30, with a noon shut down from that hour until 1 p. m., the day terminating at 6 p. m. The cost of wages is tending steadily upward, and living is not deemed cheap. Rentals, however, are cheap.

THE ST. CHAMOND WORKS.

The big iron and steel works in St. Chamond (Loire), known as "Compangnie des Forges et Aciéries de la Marine et d'Homécourt," is second in importance in all France only to Le Creusot. This plant was visited on June 25, 1908. For brevity's sake iron and steel men generally refer to this great plant by the name "Saint Chamond," probably due to the fact that in the St. Chamond district no other plant equals it in importance. The output of the St. Chamond works comprises iron and steel billets, axles, wheels, and steel tires for locomotives; rails for railways, armor plate, projectiles, and artillery equipment, ranging from field guns to the heaviest calibers. Torpedo equipment is a specialty of this concern. I found a 6,000-ton press in service, built especially for St. Chamond by Davy Brothers, of Sheffield, England. There is probably no hydraulic press on the Continent more powerful than this one. I understand, however, that it is the intention to modify this press in order to accelerate movement. It is expected that the proposed modification will increase the number of strokes by thirty or forty per minute. Two 150-ton traveling cranes operate overhead of this press. In the armor-plate department there are two rolls, disposed on each side of a 12,000-horsepower reversible engine—one for armor plates, the other for heavy or thick plates. As a rule, only Martin steel is made at St. Chamond, and in No. 1 blast there are three furnaces of 15 tons capacity each and four at 30 tons each, so installed as to permit of single ingots of 130 tons. A 150-tone crane and two 30-ton cranes are installed. No. 2 Martin is fitted with three furnaces of 20 tons each, disposed for furnishing ingots for ordinary usage and for those under 20 tons. In addition to No. 1 and No. 2 Martin there are six puddling furnaces for treating superior steel.

WELL EQUIPPED FOR ARMOR PLATE.

There is produced at St. Chamond armor plate on both the Harvey and Krupp systems, and in addition to the 6,000-ton press previously referred to there are two presses of 3,500 tons each, four large furnaces for reheating armor plate, and the necessary equipment *for tempering* by oil or water immersions; four tempering furnaces

and the necessary machine-tool equipment for finishing up armor plates to the extent of 5,000 tons per year. This machine-tool equipment is installed in two shops, each of 150 meters length and each fitted with three traveling cranes, each of 60 tons capacity. The big 6,000-ton press was built especially for working up gun and armor-plate forgings and special pieces of exceptional dimensions. In the shop containing the big press are the necessary gas furnaces for treating the forgings. In this department there is a pit 3 meters in diameter and 22 meters in depth, in which gun tubes and hoops are suspended for tempering in oil or water and for shrinking on. The total depth of this pit, including the foundation, is 44 meters. Some of the foregoing figures will give one who is acquainted with iron and steel foundries some idea of the importance of the St. Chamond works.

As in the case of Le Creusot, there are a number of subsidiary plants, and these dependencies are located at Assailly, Rive-de-Gier (Loire), Boucau, Basses-Pyrénées, Homécourt (Meurthe-et-Moselle), Maubeuge, and Hautmont (Nord). The company is capitalized at 28,000,000 francs and the stock is issued in 56,000 shares of 500 francs each. The plant was originally started in 1837 and has passed through several changes of control, but since 1874 the developments have been very marked. In addition to the plant at St. Chamond and the subsidiary works previously named, the company owns numerous mines and timber lands. At the Boucau plant Bessemer steel is produced as well as Martin steel, and at Homécourt Thomas steel is made. Speaking generally, however, artillery and armor plate constitute the most important of the St. Chamond output.

MANUFACTURE OF ORDNANCE MATERIAL, HEAVY GUNS, AND PROJECTILES.

The armor-piercing projectiles manufactured at this establishment are world famous. St. Chamond, however, does not confine itself merely to armor piercers, but manufactures shrapnel, fuses, and various forms of ammunition. Close to the St. Chamond works there is a proving ground for the test of cannon and of armor plate. St. Chamond is building field guns for various governments, and both the screw and vertical-wedge fermetures are employed. I observed that all the new breech systems permit of recocking and firing without opening the breech. St. Chamond is now locking the gun hoops through the medium of wide-thread turns. In other words, the hoops for the large caliber guns are screwed into position before shrinking in their seats.

St. Chamond was working, at the time of the visit, 8,000 men. The firm expends, as a rule, about $30,000 a year in premiums or annuities, and no trouble has been experienced here in the way of

strikes. As at Le Creusot, there is a great dearth of American machine tools in the St. Chamond works. Why this is so it is difficult to explain, but it is certain that in one instance, at least, American machine tools are not fully comprehended. I saw three tools of one American make here which are regarded as standard in the United States. These were performing mediocre work and were referred to as being very unsatisfactory. In the writer's opinion it would be well worth the while of this particular firm to send a first-class man to St. Chamond and ascertain if the criticisms are well taken. It was claimed that the tools can not work up St. Chamond steel.

AMERICAN TOOLS IN SERVICE.

I found the following makes of American machine tools in service here:

Davis & Egan, Cincinnati, planers and drills; Bickford Drill and Tool Company, Cincinnati, drills; Brown & Sharpe Manufacturing Company, Providence, R. I., grinders; Landis Tool Company, Waynesboro, Pa., grinders; Potter & Johnston Machine Company, Pawtucket, R. I., automatic turret chucking and turning machines; Warner & Swasey, Cleveland, Ohio, hexagonal turret lathes.

The foreign makers of machine tools were represented by—

Grafenstaden, vertical millers; Biétrix, St. Etienne, planers; Bouhey, Paris, lathes; Charton & Byland, Lyon, planers; P. Huré, Paris, lathes; Sculfort & Fockedey, Maubeuge, lathes; H. Ernault, Paris, lathes; Alfred Herbert, Coventry, England, turret lathes; L. Sterne & Co., Glasgow, grinders; Taylor & Hobson (Limited), Leicester, England, tracing machine; Barinquand & Marre, Paris, large line of small tools for small work; G. Buckstone & Co. (Limited), Leeds, England, planers; Thos. Shanks & Co., Johnstone, Scotland, two lathes each 21 meters and capable of being used together so as to handle in the swing a piece of work 264 feet long. Most of the heavy rifling tools have been furnished by Grafenstaden.

St. Chamond has actually built one shaft 25 meters in length. This shaft was exhibited at the Paris Exposition. One of the Grafenstaden drills is capable of being worked at any angle. In the screwing on of gun hoops an electric machine is utilized, and, although the lands and grooves are very wide, the screwing-on work must be done very quickly, otherwise the hoop may catch before it is in place. I noticed that the engine for operating the armor-plate rolls is of German make.

A specialty is made of the manufacture of chassis frames for automobiles. I understand this firm sends many of these chassis to America. These frames are pressed hot and by one operation. In the course of a visit at one automobile house, it was remarked that one reason why the American chassis frames were not equal to the French was due to the fact that American shops do not press the frames hot; that is, the American practice is more generally to press cold, and that in order to get the best results such frames should be

hot pressed. This latter method, it is declared, makes it possible to use harder material. I was told that at the St. Chamond works nine out of ten chassis frames are hot pressed.

The St. Chamond works appear to be very busy, and this is not to be wondered at when the high grade of material turned out from this establishment is considered. St. Chamond steel is world-renowned, and the artillery of this concern may be found in the armies of many foreign countries. There is very little old equipment in the works, and throughout the visitor is impressed with the fact that this establishment is of the very highest order.

THE FIRMINY IRON AND STEEL WORKS.

The iron and steel works known as "Société Anonyme des Aciéries et Forges de Firminy" are very similar to the St. Chamond Works. As stated in a previous report, the country stretching from Le Creusot to St. Etienne is the Pittsburg territory of France. Iron and steel constitutes the important outputs in this region. The writer has not attempted to cover all the firms in this territory, but rather to take representative concerns in various localities. Le Creusot, St. Chamond, and the Firminy works constitute three of the most important of these French iron and steel works and, speaking generally, these three plants differ from one another only in the number of men employed. I do not mean to say that each firm has not some distinguishing characteristic; on the contrary, there are features of distinct interest found at each plant, and in the case of Firminy one is impressed with the special grades of steel turned out for automobiles, projectiles, and engine parts.

HIGH-GRADE STEEL PRODUCED.

Director-General Adolphe Hugot personally escorted me over the Firminy works June 26, 1908, and afforded me every opportunity to inspect the plant. This company was organized as early as 1854. It was not then a limited company, but was known rather as "La Société des Aciéries et Forges de Firminy." In 1867 the firm was made a limited company. I found that the Firminy works were employing about 2,800 men. Steel is made here largely on the Siemens-Martin process, and there are two principal foundries for casting. The grade of steel turned out is of very high order, and Firminy is called upon to furnish many of the gun tubes used in French ordnance. This establishment does not attempt to work up these tubes except in the rough. As might be expected in steel works of this character, I found a great deal of material in process of manufacture for railways, tramways, and mines. The projectile department is one of the most important in this plant, and the name "Firminy" is well

known to American ordnance men. The automobile department confines itself to the manufacture of special steel parts, such as shafting, moving engine parts, axles, and turning gear. Firminy has recently brought out a new steering device.

CHARACTER OF TOOLS USED.

In the foundry and steel shops the tools are of the usual heavy massive type demanded on rough work, and all are either of English or continental make. The only exception was a Detrick & Harvey, Baltimore, planer. I found quite a large number of Chicago Pneumatic Tool Company tools in service. Other American makers were represented by Bickford Drill and Tool Company, Cincinnati, drills; Potter & Johnston Machine Company, Pawtucket, R. I., automatic turret chucking and turning machines, and W. F. & J. Barnes Company, Rockford, Ill., drills.

Firminy is using Potter & Johnston automatic tools on projectiles. There are five of these Potter & Johnston machines installed. The Pawtucket house sent a representative to Firminy, I am told, direct from America, and this representative evidently did his work well, for he has placed those five tools in high favor at Firminy. In every instance coming under the writer's notice where an American firm has sent an expert man to a European shop the visit and instruction given by the representative are referred to in high terms. The tools, in consequence, are worked to greater efficiency and become a subject of shop pride. On the other hand, there are the three American tools (referred to in a previous report) standing in the Saint-Chamond shops, and disliked because they are not understood. In the automobile department I observed a model or duplicate of the crank shaft used in the Farman aeroplane machine. The English firms represented here are Greenwood & Batley, of Leeds; Alfred Herbert, of Coventry; Thos. Shanks & Co., Johnstone, Scotland. The German Grafenstaden works have supplied most of the vertical slotting machines. Bouhey, of Paris, has supplied boring mills.

OUTPUT OF THE PLANT.

Firminy draws iron ore from Algeria and from the Pyrenees. Most of this ore is worked up on the Siemens-Martin system, but puddled steel also forms a part of this plant's output. Another important part of the firm's output is the manufacture of wire for pianos, guitars, and mandolins. In the manufacture of projectiles, shells are worked up to 42 centimeters caliber.

From all appearances the business at the Firminy shops is excellent. This view coincides with the impressions received throughout

the entire St. Etienne district. In fact, I am inclined to think that the iron and steel business in central France is more prosperous than elsewhere on the Continent. Certainly, the French plants have more work in hand than was apparent earlier in the year 1908 in other European sections.

WORKS OF LEFLAIVE ET CIE., ST. ETIENNE.

Throughout the iron and steel sections of France I observed that many of the heavy tools in service bore the stamp of Biétrix, Leflaive et Cie., St. Etienne. At St. Chamond, for example, there were no less than 12 Biétrix planers in service, capable of handling the largest size of armor plate, and at other shops I noted fine installations of tools from this St. Etienne firm. It was therefore with no little interest that I called (June 27, 1908) at the works of Leflaive et Cie., for this is the name now assumed by the house formerly known as Biétrix, Leflaive et Cie. I was received personally by Mr. Leflaive, the head of the firm, and in his company was afforded an opportunity to inspect all parts of the works. Mr. Leflaive informed me that he was employing at that time about 900 men, and the shops appeared to be busy. Two new shops were approaching completion; the buildings were up, but the installations had not been effected. The new buildings are for foundry and motor construction, respectively.

WORK TURNED OUT—AN EFFICIENT STAFF.

Leflaive et Cie. are turning out turbine engines of the Curtis type, briquette-making machinery, heavy duty machine tools, boilers, mining machinery, and petroleum motors. The turbine work is carried on under arrangements with Thomson-Houston, of Paris. Leflaive et Cie., I was told, produce the castings and machine all parts, leaving to Thomson-Houston the supplying of electrical equipment. Leflaive et Cie. seem to have as efficient a foundry staff as has been noted on the Continent. I saw some complete castings here of practically all the rigid parts of horizontal engines of, say, 10,000 horsepower.

I have had occasion to remark before that French foundrymen understand casting work to an extraordinary degree of perfection. Leflaive et Cie. use almost exclusively Martin steel as turned out by the neighboring French steel mills. For the cylinders of the petroleum engines steel mixed with chrome is used. All tool steel employed here is manufactured by the firm itself from French steel and is designed for high-speed duty. As a rule one finds only Martin steel manufactured in the St. Etienne district. In the east of France there are a number of Bessemer mills. Observing a Curtis turbine engine in process of construction, Mr. Leflaive remarked that this was

the first Curtis turbine his firm has attempted. The workmanship was good. I noticed a big Rateau blower fan, building for use in the mines, and learned that many others are in construction. The first fans of this system were created here twenty years ago.

BRIQUETTE-MAKING MACHINERY.

Briquette-making machinery has been a specialty of this St. Etienne house for the past ten years. The machines are stoutly built, and the pockets for shaping the coal briquettes are bushed with brass. The coal is fed in dust form and is mixed with coal tar sufficient in quantity to form a matrix for binding. These Leflaive briquette machines are not manufactured in America, and I understand that the St. Etienne firm will be glad to establish American connections.

The tools manufactured by Leflaive et Cie. are for heavy work, and comprise planers, horizontal boring mills, vertical boring mills, universal radial drilling and milling machines, heavy lathes for turning shafting and guns of the largest calibers, and heavy multiple vertical drills. The St. Etienne firm does not attempt to make any tools of the small or middle-sized variety. I found many old tools and many which are quite new, for like most European shops Leflaive et Cie. are no exception to the rule of holding on to old tools so long as they render good service. This, as pointed out in previous reports, is the general practice on the Continent.

AMERICAN TOOLS EMPLOYED.

The following American machine tools were in use by Leflaive et Cie.:

Bickford Drill and Tool Company, Cincinnati, Ohio, drills; J. E. Snyder & Son, Worcester, Mass., drills; Cincinnati Machine Tool Company, Cincinnati, Ohio, shapers; the Acme Machinery Company, Cleveland Ohio, threader.

The foreign machine tools included tools of the firm's own make, boring mills from Deutsche-Niles, Berlin; turret lathes from Alfred Herbert, Coventry, England, and horizontal boring mills from E. Matrot & Co., Joinville. Still others represented were Ducommun, Mulhouse; Bariquand & Marre, and Bouhey, both of Paris; Richards & Co. (Limited), of Broadheath, England, and Reinecker, of Chemnitz.

There will be a large number of tools required for the new petroleum shops, and I understand that orders have been placed which will draw on some of our Milwaukee and Cincinnati firms. The new shops for the building of petroleum engines is a connection of the Leflaive firm. The petroleum engines to be built here are the design of Mr. Sabathé, an engineer of Leflaive et Cie. Mr. Sabathé will manage the new shops. This gentleman has been working for the past ten years on problems connected with the utilization of petroleum engines for marine purposes. At the present time Le Creusot is turn-

ing out some petroleum engines on Sabathé designs for the French navy. I understand that the first petroleum engine installed in a French submarine was designed by Mr. Sabathé.

NEW PETROLEUM ENGINE.

My attention was called to a 750-horsepower Sabathé petroleum engine now being built in the Leflaive shops. The tools to be installed in the new shops now building will be run by one of these Sabathé motors. This will make it possible to have the petroleum engine under constant supervision with a view to noting any defects which may arise. Combustion is effected in these Sabathé engines by compression and not by electric spark. I understand that Mr. Sabathé has in hand the preparing of designs for a French torpedo-boat destroyer of 500 tons displacement. The design calls for three screws, the outboard screws being operated by two engines placed in parallel, and the center screw by an engine placed forward of the others. The armament consists of two rapid-fire guns of 100-millimeters caliber, six guns at 75-millimeters caliber, and two torpedo tubes. Each engine has eight cylinders, and when cruising at 19-knot speed it is proposed to use the center screw only. For speeds above 19 knots and under 25 knots the center screw will be stopped, and the two outboard engines used. For speeds above 25 knots all three engines will be brought into play. The designs call for a total engine weight of 220 tons, and at a speed of 14 knots the cruising radius is estimated at 4,800 knots. The fore and aft length occupied by one of these engines of eight cylinders is 11 meters, and the height from bedplate to top of cylinders is 2.9 meters. Mr. Sabathé estimates that 22 tons of petroleum will suffice for this vessel for a 1,200-mile run, assuming a 14-knot speed, and that the same vessel would use 52 tons of coal for this distance at the same speed. The calculations of Mr. Sabathé call for a petroleum consumption at 14-knot speed of 0.185 kilos per horsepower per hour. It is estimated that this vessel will develop 850 horsepower effective when making 14 knots, and 9,200 horsepower effective when attaining a speed of 30 knots.

Mr. Sabathé's designs for marine installation call for one type of engine only of eight cylinders. An engine of his design when making about 300 turns per minute will, he claims, develop an effective horsepower showing of between 2,500 and 3,000 horsepower. For a vessel of 1,000 tons this engine, he considers, can afford a maintained speed of 19 knots on a consumption of petroleum of kilo 0.190 per effective horsepower. For a reciprocating engine using coal, he estimates the coal consumption at 1.200 kilos per effective horsepower. Mr. Sabathé says that one of these petroleum engines can be reversed in about twelve seconds without need of any special reversing engine. I understand that the cost of one of these 3,000-horsepower petroleum engines delivered at Havre is about 960,000 francs.

SWITZERLAND

MACHINE-TOOL TRADE IN SWITZERLAND.

MACHINES AND TOOLS IN SWITZERLAND.

The observations on Swiss machinery works and references to the work in hand must be understood as relating only to the early part of April, 1908.

Zurich is the center of industrial Switzerland. Within a comparatively short radius are the great electrical houses of Oerlikon and Brown, Boveri & Co., the machinery works of Escher, Wyss & Co., the Schweizerische Werkzeugmaschinenfabrik Oerlikon, Sulzer Bros., and the Schweizerische Locomotive and Maschinenfabrik. From the center of Zurich no one of the foregoing plants is distant more than one hour's ride. Brown, Boveri & Co. are located at Baden, while Sulzer Bros. and the Swiss Locomotive Works are in Winterthur. Both Baden and Winterthur are reached by fast train service within 45 minutes from Zurich.

To understand properly industrial conditions in Switzerland it must be borne in mind that the country produces no coal and no iron ore. For the manufacture of machinery raw material is brought in for the most part from Germany; the latter country also supplies the greater part of the coal which is used. It is a curious fact that some of the Swiss firms are paying less for this coal than is charged in Germany, according to statements made by responsible officials. The iron ore is for the greater part brought up to Mannheim on barges and thence train hauled into Switzerland. In the winter season, when the water is generally too low to admit of river service, the cost of transportation often increases from 25 per cent to 30 per cent.

ENORMOUS WATER POWER.

While Switzerland is lacking in iron and coal the country can boast of an enormous amount of water power, and in the development of this power the Swiss have gained a preeminence in water turbine work throughout the world. As an instance the firm of Escher, Wyss & Co. was called upon to design the original water turbine which was installed at Niagara Falls. Hand in hand with the water-turbine development one sees practically the superlative in electrical engineering, and to-day Swiss machinery is being sent to all parts of

the world. Handicapped as the Swiss are in natural resources they are able to maintain their position in the outside world only through superior technical knowledge, and in this knowledge they have much for which to thank their engineering institutions. They can lay claim to much practical experience, and were probably the first to develop electrical transmission over long distances. Their experience in this line has been so satisfactory that it will not be surprising to find a majority of the Swiss state railways working before long under electric power. This is the present tendency, and the opinion is expressed at Oerlikon that eventually the single-phase system will be employed.

I find that the majority of the workmen are paid less in Swiss shops than in those in the Berlin territory, and perhaps a little better than in the Chemnitz district. The hours of work range from ten to ten and one-half, and there appears to be as much care and attention bestowed on the welfare of the employees as in the best shops in Germany. Conditions among the workmen do not appear to be as settled as was the case a few years ago, and from leading officials I am informed that the men are constantly coming and going. In the case of one shop the beginning of each month finds about 50 per cent new men. I am inclined to believe, however, that this is an exceptional case, and that from 20 per cent to 25 per cent would more accurately represent the conditions, generally speaking.

HIGH-GRADE TOOLS REQUIRED.

It is a curious fact that Switzerland has only one machine-tool house, and this was organized as recently as May, 1907. The Swiss as manufacturers of high-grade machinery demand the best machine tools the market affords, and nowhere in Europe can a better display of American machine tools be found than in Swiss shops. In several of the big works about 80 per cent of the tools are of American make, and the writer has no hesitancy in asserting that this is one of the best markets in Europe for high-grade American machine tools. I asked the director of one of the largest works here what method he employed when he wished a new tool. He replied that he generally communicated with four agencies, the names of which he mentioned, where he knew the best tools were obtainable. Three of these agencies handle American machine tools; the fourth was a German concern. The director told me that one of the American agencies sent him on the first of every month a statement of just what tools were being carried in stock and how quickly a delivery could be made. These monthly statements, the director said, were very convenient, because they admitted of being readily consulted. One German firm, he informed me, is taking up this same method. From what I can

learn, there does not appear to be any direct representation from American firms. There has been an occasional caller, but as a rule the sale of American machine tools has been left to foreign agencies. An instance was cited to me, however, where an American representative came to a shop, and on finding that a turret lathe which had been purchased from his company was neither understood nor appreciated—in fact, was not liked—remained at the shops for about ten days and worked at this tool. He showed the men in the shops not only how to work the tool, but what it would accomplish, and with the result that this type of machine is now in high favor in that establishment.

AMERICAN TOOLS STAND HIGH.

In one of the big electrical houses, where a superintendent has been taken on who has had American experience, and who understands American machine tools, it was found possible to reduce the cost of machine work on a certain make of pulleys from 3 francs each to 60 centimes. Previously the work had been performed by an ordinary lathe. The reduction in cost was effected by using one of our well-known makes of turret lathes. In citing this fact to me, the superintendent remarked: "I propose to put in two more of these turret lathes in a very short time."

So far American machine tools have held their own among Swiss shops, by reason of merit, but the best class of German tools are gaining a foothold, and this competition will have to be met. If the general sales manager, or an official equally responsible, could find time each year to put in several weeks of serious work among the machinery establishments on the Continent, he would readily ascertain the needs of this territory. This work should not in the least interfere with any agencies which may have been established abroad, but should rather serve to strengthen and assist such connections.

PRESENCE OF PERSONAL AGENTS NEEDED.

There are in Europe several American representatives of machine-tool houses attached to the offices of their foreign agents. These representatives act in a dual capacity, namely, representing the home house and assisting the foreign agencies in illustrating the working features of some particular tool. This plan seems to have much to commend it, but it does not go far enough. The business conditions should be known to the sales manager or some other responsible officer as thoroughly as the home market, and this can only be accomplished by personally meeting and talking with the men who use machine tools. The point of view of the latter is an independent one, and for that reason their expressions and opinions

are valuable. As an instance, I have seen in one machinery establishment three American machine tools of one pattern working close to a single American machine tool of another make. The superintendent informed me that this single American tool accomplished as much work as the three American tools of another manufacturer's make. This view arose from not understanding the full possibilities of the three American machine tools. There is no doubt that the single American tool referred to is one of the best of its make in America—and so also are the other three—and yet when this foreign firm adds to its equipment I doubt very much if it will draw on the latter, this being simply because the working possibilities of the machines are apparently not fully understood.

MASCHINENFABRIK OERLIKON, ZURICH.

HIGH STANDARD OF OUTLAY—AMERICAN TOOLS USED.

The Swiss electrical house known as Maschinenfabrik Oerlikon enjoys a world-wide reputation for the excellence of its output. About 2,000 men, women, and girls are carried on the pay rolls. This statement was made to me on April 1, 1908. Many of the machine tools in use in this establishment are of American make, and the installation is a superb one. The character of the work turned out by Oerlikon is of such a high standard that as a rule only the most accurate tools can be employed, and it is the policy of this firm to install the best machine tools obtainable regardless of origin. I found on the Oerlikon floors the following makes of American machine tools:

Jones & Lamson Machine Company, Springfield, Vt., turret lathes; Prentiss Brothers Company, Worcester, Mass., drills; F. E. Reed Company, Worcester, Mass., lathes; Brown & Sharpe Manufacturing Company, Providence R. I., millers and grinders; Potter & Johnston Machine Company, Pawtucket, R. I., automatic turret chucking and turning machines; G. A. Gray Co., Cincinnati, Ohio, planers; Pratt & Whitney, Hartford, Conn., lathes; E. W. Bliss Company, Brookland, N. Y., stamp machines; Cleveland Automatic Machine Company, Cleveland, Ohio, automatic machines; Colborn Machine Tool Comapny, Franklin, Pa., boring mill; Landis Tool Company, Waynesboro, Pa., grinders; Lodge & Shipley Machine Tool Company, Cincinnati, Ohio, high-speed engine lathe; Dresses Machine Tool Company, Cincinnati, Ohio, vertical drills; Cincinnati Milling Machine Company, Cincinnati, Ohio, millers; Niles Tool Works, Hamilton, Ohio, heavy planer; W. F. & J. Barnes Company, Rockford, Ill., drills; Gisholt Machine Company, Madison, Wis., turret lathes and boring mill; the National-Acme Manufacturing Company, Cleveland, Ohio, four spindle automatics.

The foreign makers represented were:

Herbert, of Coventry, and Darling & Sellers (Limited), of Keighley. There were also some tools from Kendall & Gent and from Richards. These four firms, however, contributed the only English tools the writer saw. German

makers were represented by Ludwig Loewe, the Wanderer Works, and Grafenstaden, and a few works of less importance. There were also present a number of tools from the Swiss machine-tool house known as Werkzeugmaschinenfabrik Oerlikon.

RELATIVE MERITS OF VARIOUS TOOLS.

The opinion was expressed by one of the directors that the Lodge & Shipley high-speed engine lathe was superior to any foreign lathe in the shop, and that this particular tool yielded a saving of 30 per cent in cost of production over any foreign lathe, barring only that of Darling & Sellers. The opinion is held at Oerlikon that the Herbert English turret lathe is better than some of the American makes. The Potter & Johnston automatic lathe is held in high favor, and the opinion was expressed that this machine was not yet approached by any of the copied attempts in Europe. The Dresses Machine Tool Company drill and the Bliss stamp presses were highly commended. With reference to the former machine one of the directors remarked, "We can do almost any work with it." There was not a tool in the list given above of American machines which was not well spoken of at Oerlikon. It was intimated, however, that Oerlikon considered the prices charged in a few cases as not warranted by reason of the close approximation of the best class of German tools. As to alleged defects in workmanship of American machine tools, one of the directors declared that in his opinion these defects did not exist with the best firms, but rather with the less responsible plants. In the case of some of the cheap-grade tools it has been noticed that ordinary magnolia-metal bearings have been let into cast-iron frames, but such complaints could not be made against the best makes of tools. As remarked above, a firm like Oerlikon is out at all times for the best machine tools obtainable, and the statement was made that any new American machine tools would be welcomed at Oerlikon so long as it could be shown that the machines possessed merit and are capable of producing work cheaply and quickly.

The workmen in the shops are not permitted to use measuring tools, but must work entirely to caliper sizes.

There is hardly any line of electrical light, power, and traction apparatus that is not handled by the Oerlikon plant, and from almost the first stage of electrical development in Switzerland the firm has been an active participant. Aside, however, from the general manufacture of generators, a specialty is made of electrical pumping and rolling-mill installation, electrical winding gears, and locomotives. Oerlikon also turns out electrically driven overhead traveling and revolving cranes, and this department is one of the most important in the firm's business.

I observed that Oerlikon is building steam turbines under special designs, and that these works are owners of Rateau's patents for a great number of countries. The Rateau is of French origin.

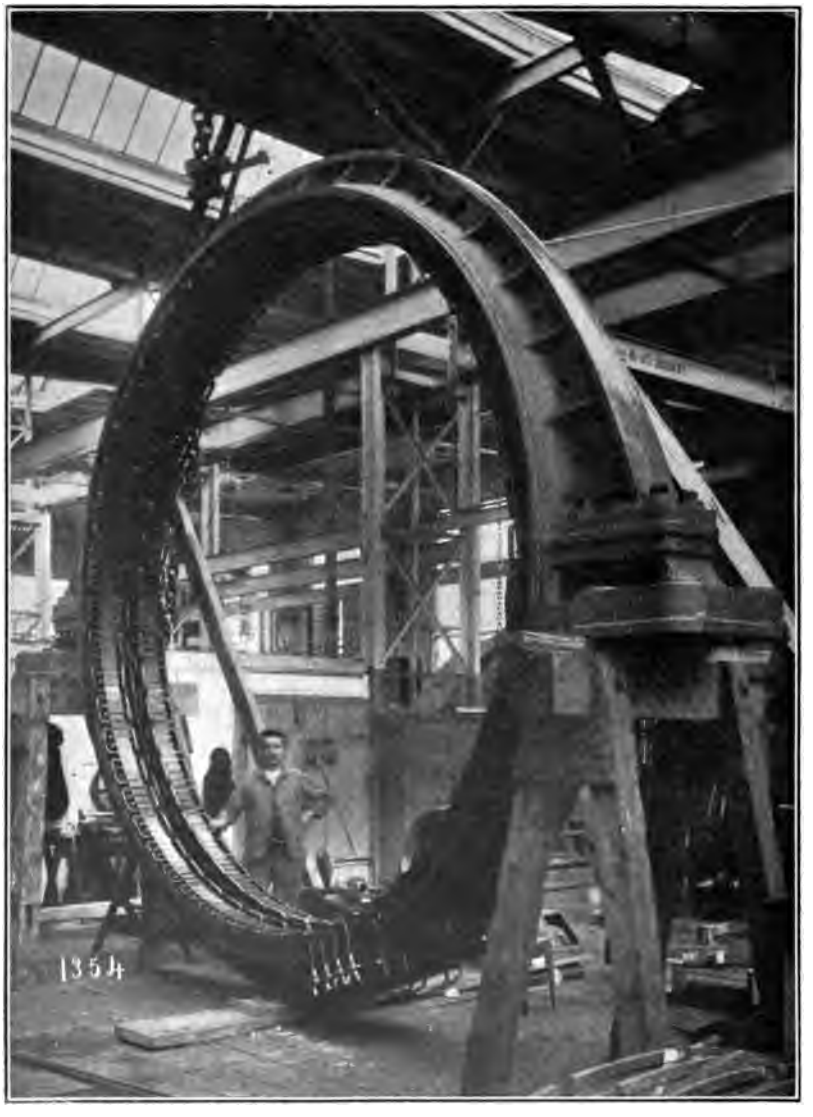

FIG. 18.—Electrical work at the Oerlikon (Swiss) shops.

Until quite recently the Oerlikon works also built to a limited extent machine tools, and this is the reason why the great majority of the machine tools put up in the shops are of their own make; but owing to the demand of the electrical business it was found necessary

to give up machine-tool construction. This branch of Oerlikon has been taken over by the new Swiss machine-tool house known as Werkzeugmaschinenfabrik Oerlikon. Naturally the output of the new Swiss machine-tool house will be availed of whenever possible. This concern was established May 1, 1907. This is the only firm in Switzerland which devotes itself exclusively to building a general line of machine tools. It is an offshoot of the Swiss electrical house known as the Maschinenfabrik Oerlikon. The electrical business of the latter increased to such proportions as to make it necessary to abandon machine-tool construction, and in consequence an independent firm was inaugurated, carrying with it the good will of the Oerlikon plant.

WAGES AND CARE OF WORKMEN.

Of the 2,000 people employed by the Oerlikon works 50 per cent represent a floating force. A good tool man at Oerlikon earns between 5 and 7 francs a day ($0.96 to $1.35), but the tendency is toward higher wages. The last three or four years most of the working plants in Switzerland observed an increasing tendency on the part of the workmen to float about. In 1907 it was almost impossible to get the necessary number of workmen, and so the rates of wages increased considerably. This is not surprising, since the present rate of pay of a Swiss shop is less than in the Berlin plants. The living cost of workmen in Zurich in proportion to the cost in America is, roughly, in the ratio of about 1 to 2½ or 3.

The Oerlikon firm provides both breakfast and dinner for the employees; that is, for those who care to avail themselves of these facilities. Dinner costs about 10 cents American money, and generally consists of good soup, pork and beef, cabbage, potatoes, and bread and butter. A man can have all the soup he wants, but the remainder of the meal is served out in portions. For breakfast milk and coffee, bread and butter are provided, and the firm pays one-half. The breakfast idea is to insure that the men start work in the morning on nourishing food. Baths are provided at a charge equal to 2 cents American money, and this includes soap and towel.

The following wages are paid: Fitters of the better class, 7 to 8 francs per day; skilled men on lathes, milling, and planing machines, 6 to 7 francs; other than skilled men on drilling machines, capstan lathes, and small machines, 5 to 6 francs; shop men for varied sorts of work, 4 to 5 francs. (1 franc=19.3 cents.)

THE OERLIKON MACHINE-TOOL WORKS.

The Werkzeugmaschinenfabrik Oerlikon is the one Swiss firm engaged to any notable extent in the manufacture of machine tools. The works are located close to the sh

April 1, 1908, about 250 men were employed. Even in the short time in which the establishment has been in existence orders have been taken for deliveries in Italy and Germany, and several of the tools produced exhibit a high order of merit. In general, however, it undertakes to manufacture a full line of machine tools, and at the same time is specializing on several tools for automobile and locomotive works.

VARIETY OF TOOLS PRODUCED.

The list of tools manufactured comprises lathes, both of the engine and turret types, boring mills, horizontal boring and milling machines, universal boring and milling machines, double horizontal boring and milling machines, radial drills, drill presses, vertical multiple spindle drills, universal milling machines, vertical milling machines, horizontal milling machines, planers, gear cutters, shapers, and grinding machines.

The special tools produced comprise automatic milling machines for the manufacture of radiators, machines for winding the ribbons around polar bobbins, machines for working up gunstocks of military small arms, machines for banding projectiles, machines for milling cone gears, machines for milling locomotive steam connections, and special machines for rolling bobbins. In this list of special tools the most noteworthy are the machines for the manufacture of radiators and those for locomotive work and cone gears.

DIFFERENCE IN EUROPEAN AND AMERICAN SHOPS.

It will be seen from the general line of tools manufactured that this firm is not in a position to devote attention wholly to any particular set of tools, and herein constitutes the difference, as previously noted, between the general run of European and American shops. The European manufacturer is, as a rule, unable to confine himself to any one tool because of a restricted territory for the sale of this product. He must, perforce, in order to keep his shops going, obtain orders for machine tools wherever he can. The new Swiss machinery house should naturally and rightly hope to attain a fair share of Swiss business on the ordinary run of tools, and the evidence that the firm is making progress is seen in the fact that it is securing orders in Germany and Italy. The German orders were mostly for the arsenal tools, while the machines for automobile construction were sold in Italy.

The shops of the Werkzeugmaschinenfabrik Oerlikon are wholly new, and have been built with every attention to modern needs. The works can be reached from the city of Zurich in about half an hour's time by street car and in about ten minutes' time by train from the *central station.*

WORKS OF ESCHER, WYSS & CO., ZURICH.

No firm in Europe is better known in turbine construction than Escher, Wyss & Co. (Limited), of Zurich, Switzerland. There is a branch establishment in Ravensburg, Wurttemberg. The parent plant was founded in 1805, and the firm has been identified with almost every step of development in water-turbine construction. There can be found on the floors at the Escher-Wyss plant almost every form of water turbine which Swiss experience recommends. It was this firm which was called upon to design some of the earlier turbines for

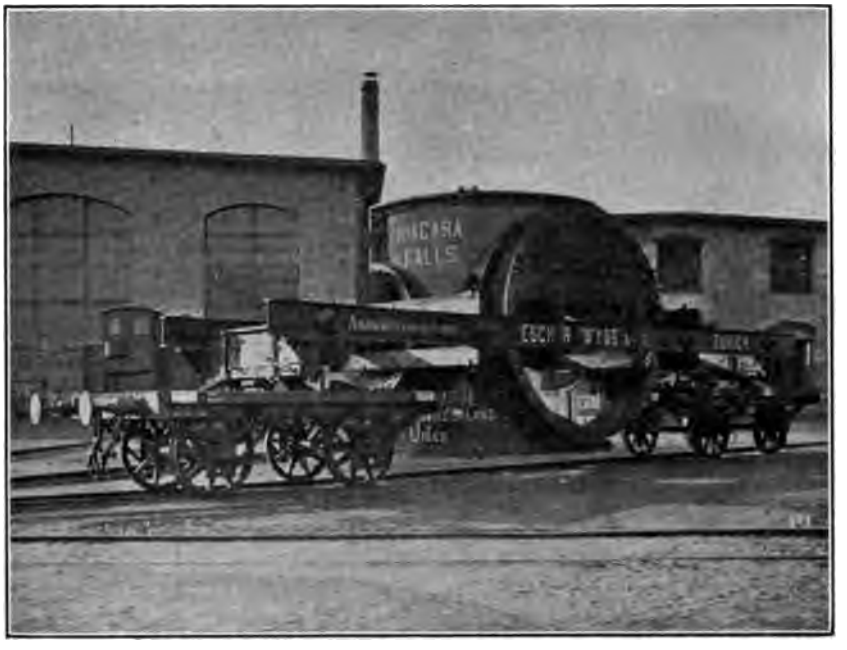

FIG. 19.—Turbine built by Escher, Wyss & Co., Zurich, for power plant at Niagara Falls.

one of the Niagara Falls power plants, the actual building of the turbine being undertaken by an American firm. In the case of one of the power companies on the Canadian side of Niagara Falls, the turbine was built by Escher, Wyss & Co., and shipped to Canada. Escher, Wyss & Co. were working, April 2 and 3, 1908, about 1,800 men. A large proportion of the tools in use are of American designs. Jones & Lamson lathes seem to be much in favor, and among the very latest tools installed is a Detrick & Harvey planer. Most of the American machines, however, carry only the name of a Cologne agency. Ernst Schiess, of Düsseldorf, has supplied a large number of the heavy tools that are used, and there is also a good stock of Graf

enstaden tools. A good lathe man at Escher-Wyss receives about 50 centimes per hour, and a workday varies from ten to ten and one-half hours.

While Escher, Wyss & Co. have in the past largely devoted their energies to water turbines they are now bringing out steam turbines for both land and marine use. Their shops do not require as varied a line of tools as, for example, the Oerlikon works. For the heavy work the German tools appear to be for the most part utilized. For work on the finer parts of the steam-turbine wheels American machine tools are in demand.

SIMPLICITY AND SOLIDITY IN CONSTRUCTION OF STEAM TURBINES.

Escher, Wyss & Co. are building a steam turbine known as the "Zoelly," which for simplicity and solid construction is coming into high favor on the Continent. The new turbine is a parallel-flow "simple action" one with pressure stages, and with a minimum number of stages of nine or ten. It differs from the reaction turbine in several essential points. In the latter the pressure is converted into steam partly in the guide apparatus and partly in the turbine wheel itself, so that there is always a difference in pressure between the two sides of the wheel. This sets up longitudinal thrust and occasions some loss of steam through the clearance between the wheel and the turbine parts. In order to reduce the loss of steam the radial clearance is brought down to a minimum, and unless there is very careful workmanship may give rise to fatal results to the engine. In order to take up the axial thrust, recourse is generally had to a special balancing piston, and this piston also rotates.

In the case of the Zoelly turbine, the pressure is converted into steam exclusively in the guide apparatus. The steam enters the turbine wheel with its pressure preserved and is not lowered in passing. As there is neither axial thrust nor leakage a large radial clearance can be allowed between the turbine wheels and stationary parts. In this new Zoelly steam turbine, which may also be described as a simple-action turbine, the steam jet from each guide apparatus acts on one wheel only. The steam on being admitted to the turbine passes on to the first guide apparatus, in which it is partially expanded, and so acquires kinetic energy, and is further directed at the proper angle to the running wheel, which absorbs the energy corresponding to the first expansion. The steam then passes to the second guide apparatus, where the second expansion takes place, and in like fashion the steam works through all the wheels and passes out to the exhaust pipe. Each guide apparatus consists of a disk divided along its horizontal diameter, and is made of cast steel or cast iron in one piece with a distributing ring. The blades are of nickel steel, and

the whole apparatus is very solid in construction. The construction of the runners appears perfected to a high degree of reliability. Each turbine wheel disk is made of high-grade steel forged in one piece at the boss, and is carefully turned and polished all over. The

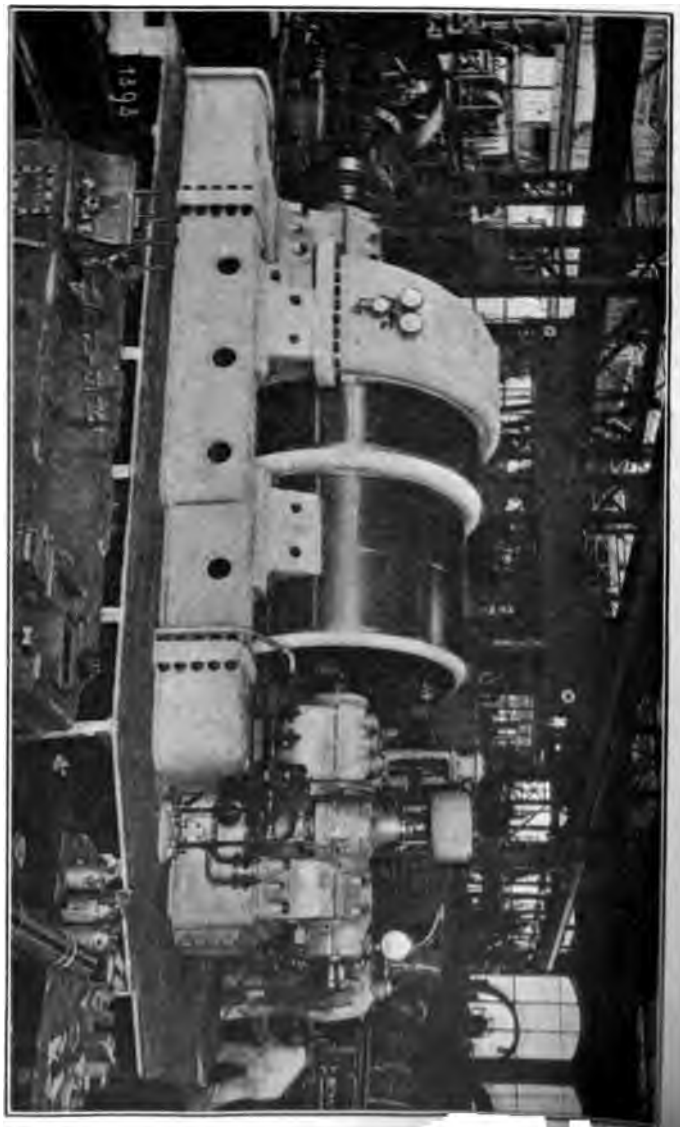

FIG. 20. 10,000 horsepower Zoelly steam turbine for the Electricitäts-Werken, Essen, Germany.

blades are thickened toward the center i[illegible] of the metal the same at every radius.

The Zoelly has only about one-thir[illegible] blades of a multi-stage reaction steam [illegible] and the average velocity of the [illegible]

blades is not appreciable. The Zoelly seems to be regarded in high favor in Germany, and is especially commended by reason of the little care and attention that is necessitated. I have seen one of these turbines working under very low pressure, utilizing in fact exhaust steam, at one of the colliery pits, and I understand that the engine requires no extensive warming up before starting, and for this reason is valuable as a reserve machine.

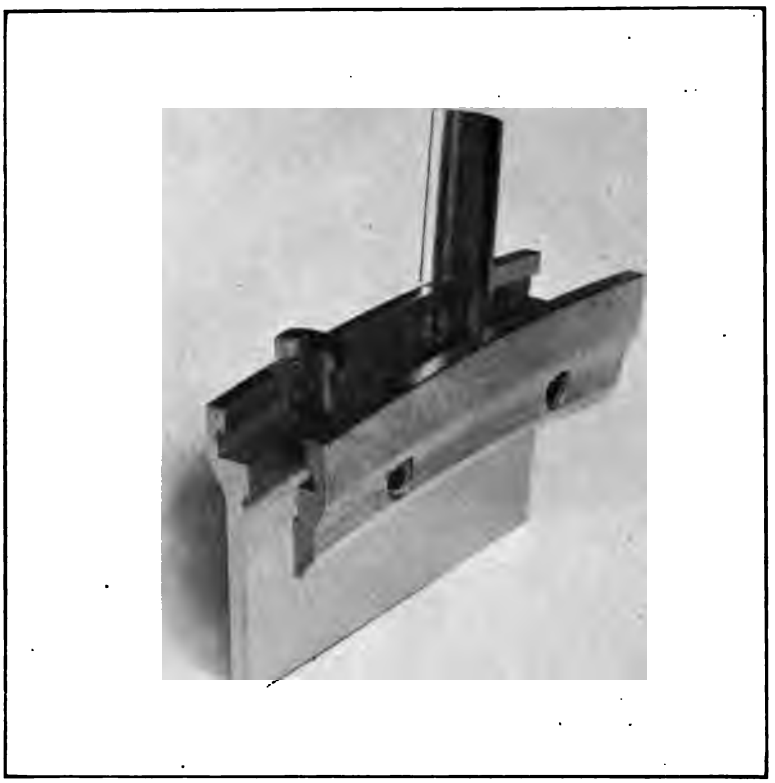

FIG. 21.—Zoelly steam turbine-wheel segment.

MARINE TURBINES—ENGINES FOR GERMAN SCOUT CRUISERS.

At the time of the writer's visit in early April, 1908, Escher, Wyss & Co. were building a 20,000-horsepower marine turbine engine for a new German scout cruiser of 4,500 tons displacement. The German cruiser is building at Kiel, and the 20,000-horsepower engines are expected to afford a speed of 26 knots per hour. The Escher-Wyss turbine engines are of the new Zoelly type, and their development for marine purposes is of very recent date. It will be seen from the displacement of the German cruiser and the horsepower involved that

the designs called for speedier vessels than the new American scouts *Salem*, *Birmingham*, and *Chester*.

The engine installation for the German scout involves four screws with two 6,000-horsepower engines working the outboard screws, and two 4,000-horsepower engines working the inboard screws. The four turbines are grouped in water-tight compartments, so that each engine is independent of the others. Each turbine is provided with a complete set of auxiliary engines. The turbines are designed for economical working at reduced speeds. For long cruises the lower-power turbines only are used, and the heavier engines are only brought into play for high speeds. The number of turbine revolutions will vary between 380 per minute for 14-knot speed and 580 for full speed. These revolutions apply only to the lower-powered engines; for the heavier engines the maximum number of revolutions will be 400 per minute. Each shaft possesses an independent astern turbine, which further assures great facility in maneuvering.

TURBINE ENGINES FOR TORPEDO BOATS.

In addition to the scout cruiser, Escher, Wyss & Co. have designed turbine engines for a new 450-ton torpedo-boat destroyer, and still another installation for a 650-ton torpedo-boat destroyer. In the 450-ton boat the engine output is designed at 9,000 brake horsepower. In the case of this vessel there will be three shafts, and the number of revolutions will vary between 500 and 820, according to the speed. The maximum number of revolutions of the outboard engine will be 675 per minute. The center engine is the lowest in power and is designed for economical working during long cruises at low speed.

In the 650-ton torpedo-boat destroyer the designs call for a turbine output varying between 13,000 and 14,000 brake horsepower. Each turbine is constructed for economical working at low speed, and each shaft is designed for ahead and astern working. The maximum number of revolutions at 30 knots per hour is 650 per minute. One of the above torpedo-boat destroyers is to be brought out by the German Government and the other by the French Government. The engines for the French boat will be built at Le Creusot.

In the 4,500-ton German scout steam will be used at pressures varying from 14 to 15 atmospheres. This, of course, is superheated steam, and I understand that Schultz superheaters will be used in conjunction with Thorneycroft-Schultz tubular boilers.

DETAILS OF CONSTRUCTION.

The blades of the Zoelly marine turbine are built of nickel, and the frames of Siemens-Martin steel. Krupp furnishes the greater part of the steel that is used in the construction of these engines.

This marine type of Zoelly engines differs from the land type of machine in being more solidly built. The Escher-Wyss engineers declare that the turbine is as economical as the reciprocating engine. This statement is based on good working conditions.

The engine arrangement indicated in the case of the above vessels is held to represent considerable progress over those turbines where the arrangement is by series. The connecting pipes between the turbines of the different shafts are eliminated. Each turbine represents a separate and distinct unit, capable of maneuvering independently, and remaining independent of the other turbines, in case of damage. Such an arrangement, it is declared, is not possible with the reaction type of turbines, which requires a grouping in series in order to reduce the high-pressure parts, corresponding to several shafts, to a single body. In this new Swiss turbine these drawbacks do not exist. The solid and simple construction of the Zoelly turbine appeals at once to the eye, and so far as can be seen there appear to be no delicate parts requiring any special care. All the parts seem to be simple and readily accessible, and the excellent mechanical construction seems to be ample guaranty against internal damage.

ZOELLY TURBINES FOR THE MERCHANT MARINE.

The Zoelly steam turbine is being counted on in certain European quarters to eventually offset the engines of the Cunard steamships *Mauretania* and *Lusitania*. A German limited company to exploit the Zoelly has been organized, I am informed, which comprises Krupp, of Essen, Howalt, of Kiel, the North German Lloyd, and Escher, Wyss & Co. It is an interesting fact that this interior city of Zurich is to-day producing some of the most advanced marine engineering work, and although no definite plans have yet been evolved, so far as can be learned, relative to a ship to meet the *Mauretania* and *Lusitania*, it is at least not too premature to say that the hopes of many Swiss-German engineers are centered on the Zoelly engine to accomplish this. The simplicity and solid construction of the Zoelly simple-action turbine over the reaction types in use abroad are strong points in favor of the Swiss design. Naval constructors generally need not be surprised at the announcement almost any time of the laying down in continental yards of a vessel of large tonnage fitted with Zoelly turbine engines for very high speed. I am inclined to think, however, that before anything definite in this line is undertaken the showings of the new German scout cruiser will first be carefully analyzed. The opinion is held here that the new German craft will do better than the 26 knots for which she is designed.

Krupp has obtained the Zoelly turbine rights for Germany and will build at the Germania works in Kiel. Schneider & Co. have the

rights for France and will build at Le Creusot. Orlando & Co. have secured the rights for Italy and will build at Leghorn. The American rights have not yet been disposed of.[a]

LIQUID-FUEL HEATING—NEW SYSTEM FOR MARINE BOILERS.

Escher, Wyss & Co. are also bringing out a liquid-fuel heating system for marine boilers. This involves a steam turbine-driven turbo compressor, Zoelly type. The liquid heating of marine boilers, it is pointed out, calls for compressed air at about 14 to 15 pounds per square inch, to be forced through suitably dimensioned nozzles placed over the grates. It is not practicable to use reciprocating engines for this purpose, owing to the reduced floor space of stokeholes, and to overcome this difficulty Escher, Wyss & Co. have brought out the Zoelly type of turbo compressor driven by a Zoelly steam turbine. A sketch is forwarded which indicates the over-all dimensions required for one of these machines, and the high-speed ranges, it is said, are within usual practice and permit of very light weight. The system can be operated in any position that may be required by ship conditions.

THE SWISS LOCOMOTIVE AND MACHINERY WORKS.

The Schweizerische Locomotiv- and Maschinenfabrik, Winterthur, employed April 2, 1908, about 1,800 men. This is one of the best locomotive shops on the Continent of Europe. Its engines are sent to all parts of the world. It is doubtful if there is higher finish to be found on any European locomotives than is given here, and the character of the workmanship is exacting. Here, as in Germany, it was observed that for the most part the plate-frame form of construction is being used, but the Swiss shops are about to undertake bar-frame construction, and the first set of bar frames has just been received by the Winterthur shops.

The Swiss Locomotive Works construct gas engines as well as locomotives, but the locomotive branch of the business is the larger. The care bestowed on the locomotive work is noticeable, and great attention is paid to detail. Copper fire boxes and stay bolts are the rule, as in other continental shops. The plate frames are first drilled out, but I did not observe any vertical millers for milling the interior edges of the blanks. The head of one of the departments remarked that he would like to put in a tool of the vertical-miller type for this work. The plate frames were being drilled out by Hartmann (Chemnitz) tools, and planed by tools supplied by the same firm. The new bar frames, which have just reached the Swiss shops, are of forged

[a] The writer is advised, under October date, by Messrs. Escher, Wyss & Co. (Limited) that the American rights have been disposed of.

steel, and were received from Germany. I did not understand from my talk with the Swiss locomotive representatives that it is the intention to discard plate-frame construction, but rather to use bar frames for special types of locomotives. Among the engineers in charge of departments here is one gentleman who saw service in the Baldwin Locomotive Works for several months, and whose observations on the general locomotive situation were among the best I have heard in Europe. In fact, the engineers in charge of various departments at the Swiss Locomotive Works impressed me as being men of very high order.

AMERICAN TOOLS HIGH IN PRICE.

A large number of American machine tools were in use in the Winterthur shops, and, as is usual in locomotive works on the Continent, there were also a number of the heavier types of English tools. It would seem as if the English machine-tool houses early contributed tools to the continental locomotive shops, and most of these are still in operation. It can be set down as a fairly correct statement that the English tools now being sold in Germany and Switzerland are for the most part from such firms as Herbert, of Coventry; Smith & Coventry, of Manchester; Darling & Sellers, of Keighley; Kendall & Gent, and Richards.

The heavier machine tools at the Swiss Locomotive Works, outside of those furnished by English houses, are mostly of German and Swiss (Oerlikon) design, and the American representation is largely confined to lathes, millers, shapers, and drill presses. The opinion was expressed at the Swiss works that too much money is being asked at present for the average make of American machine tools. The firm, it was stated, might recently have ordered a certain American boring mill, but the price asked was about twice as much as was demanded for a good German machine. It was correct to admit, it was said, that the American machine was a somewhat better tool, but the Swiss engineers did not think it better to the extent of nearly double the price of the German. On the other hand, it was remarked, such a tool as Warner & Swasey hexagonal lathe was a splendid machine and was worth its high price. These opinions are mentioned, as they indicate the trend of thought among men who buy and use American machine tools in Europe.

GAS ENGINES—STEEL SUPPLY.

The gas-engine building branch of the Swiss Locomotive Works is an important one, and gas engines are turned out from these shops of as high as 1,000 horsepower. The producers are of the suction-gas variety, using anthracite coal, but experiments are now under way with producers to use soft coal.

Krupp furnishes the most of the high-grade steel used in the locomotive construction, especially in the case of crank shafts and other parts demanding the best material. The Swiss locomotive shops make a specialty of rack engines for mountain grades, and this firm has probably had more experience in this line than any single shop on the Continent.

It is the writer's opinion that the Swiss locomotive shops should not be overlooked by American manufacturers. Good tools are required at this plant, and it is the policy of the firm to install only high-grade machinery. A tool possessing merit would be quickly recognized by the engineers in Winterthur.

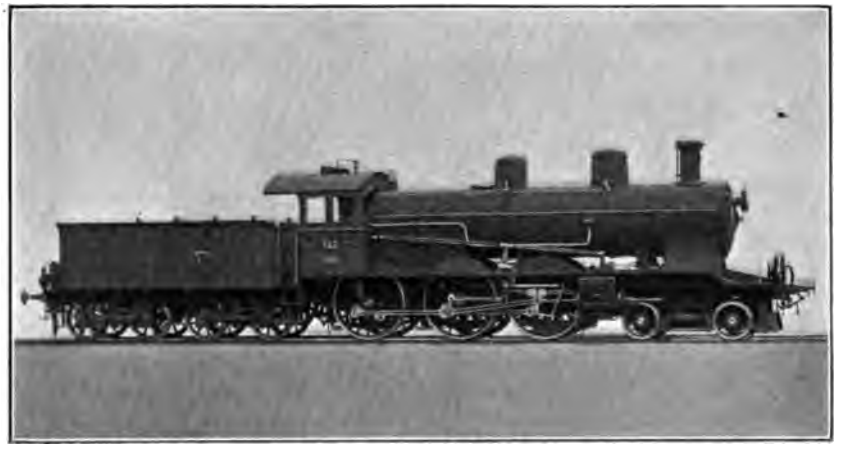

FIG. 22.—Standard high-speed locomotive, Swiss Locomotive and Machinery Works.

AID TO EMPLOYEES.

The works are undertaking a limited amount of welfare work, and about 50 families are housed in neat dwellings in close proximity to the shops. The rental charges vary from 216 francs (franc=19.3 cents) for three rooms to 300 francs for four rooms of medium size and 360 francs for four large rooms. The men of the families housed in these dwellings are nearly all members of the firm's fire brigade, and each home is connected with the fire-alarm signal.

The facilities for obtaining meals are similar to those in vogue at the Oerlikon shops, and here, as at the Oerlikon works, the Sulzer Brothers, of Winterthur, have installed the steam-cooking tubs in which soup is prepared and potatoes and meat cooked. This device of the Sulzer Brothers seems in every way an excellent arrangement.

There is a central building at the Swiss works, constructed at a cost of about $40,000, which is fitted up as eating rooms and rooms for the instruction of apprentices. The basement of the building is

divided into 53 bathrooms, similar to the arrangement at the Krupp works at Essen, and at the Oerlikon works at Zurich. The charge for a bath is about 2 cents American money. An old-age pension fund is maintained, amounting to 860,000 francs, and gives a pension

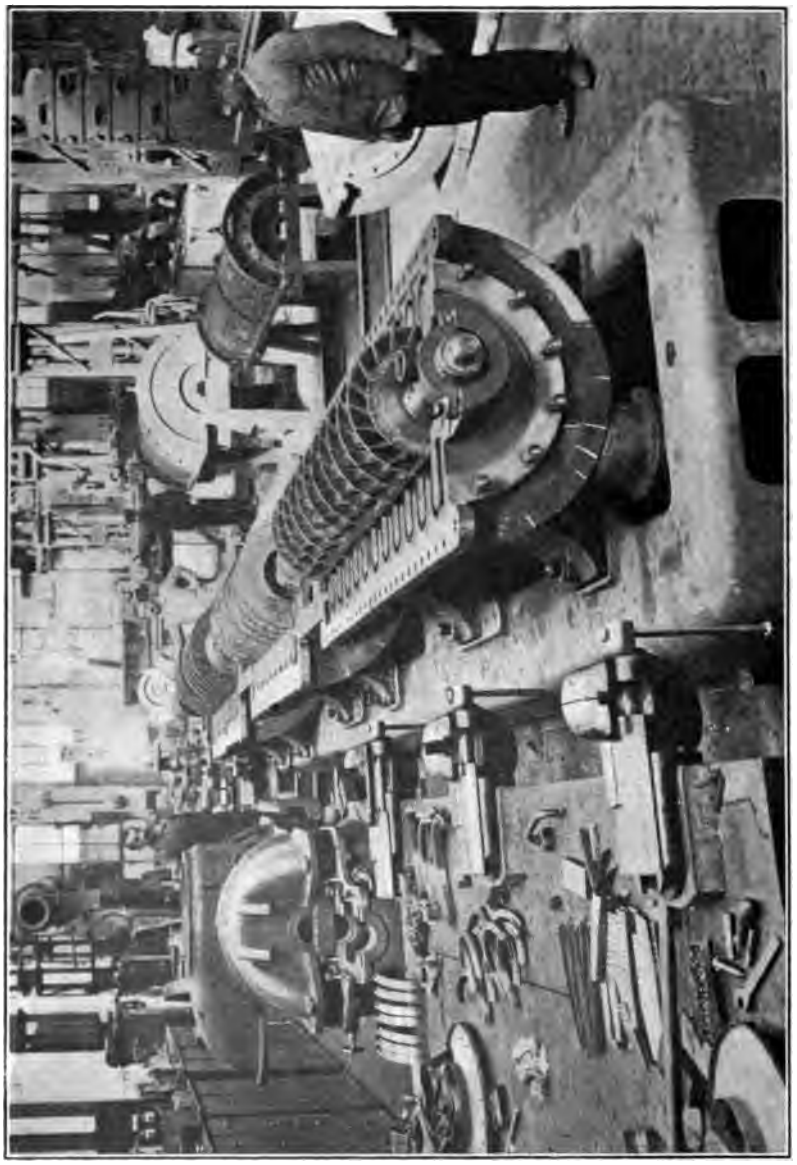

FIG. 23.—Steam turbine work, Brown, Boveri & Co., Baden.

varying from 600 to 800 francs to every person over 50 years of age who has worked for them twenty years. In the year 1908 this old-age pension fund has been increased to 980,000 francs. This is said to be the only firm in Switzerland that pays pensions on so large a scale.

ELECTRICAL WORKS OF BROWN, BOVERI & CO., BADEN.

The firm which electrified the Simplon Tunnel Railway was Brown, Boveri & Co., of Baden. Their works were visited April 3, 1908. Nowhere in Europe was seen a finer aggregation of American machine tools in service under one roof. The installation was almost tantamount to an exhibition of high-grade American tools. Added to this was an evidence of shop efficiency of high merit.

The American tools observed were from the following makers:

Ingersoll Milling Machine Company, Rockford, Ill. (milling machines); Brown & Sharpe Manufacturing Company, Providence, R. I. (millers); Cincinnati Milling Machine Company, Cincinnati, Ohio (millers); Norton Grinding Company, Worcester, Mass. (grinders); G. A. Gray Company, Cincinnati, Ohio (planers); Whitcomb Machine Tool Company, Worcester, Mass. (planers); Mark Flather Planer Company, Nashua, N. H. (planers); Warner & Swasey, Cleveland, Ohio (hexagonal turret lathes); Hendey Machine Tool Company, Torrington, Conn. (shapers); Putnam Machine Tool Company, Pittsfield, Mass. (drill press); Baker Brothers, Toledo, Ohio (shaper); Baush Machine Tool Company, Springfield, Mass. (drills); Gisholt Machine Company, Madison, Wis. (turret lathes); Lodge & Shipley, Cincinnati, Ohio (engine lathes); The Acme Machinery Company, Cleveland, Ohio ("Acme" line).

The foreign firms were represented for the most part by Reinecker, of Chemnitz; De Fries, of Düsseldorf; the Grafenstaden Works, and the English shops of Smith & Coventry, and Richards.

TECHNICAL ADMINISTRATION—AMERICAN TOOLS.

The shop efficiency at Brown, Boveri & Co.'s is very noticeable, and it is the writer's opinion that the technical administration is equal to that of the best shops of Europe. The machine-tool management is similar to what one is accustomed to see in America, and it is an interesting fact that the superintendent in the machine-tool department worked at one time in the Pratt & Whitney shops in Hartford, Conn. I found that these works were obtaining the full working possibilities out of nearly all the American tools, and my attention was called to a Gisholt turret lathe which was turning out some pulley work at a cost of 60 centimes (11.5 cents) for each pulley, as against 3 francs (58 cents) when this work was previously done on an ordinary lathe. The Warner & Swasey hexagonal lathe is in high favor in the shops, and its possibilities seem to be well understood. There was not a tool in the American list that was not well spoken of, and it is the writer's opinion that any American tool possessing high merit will receive ready consideration by Brown, Boveri & Co. The Baden works make a practice of selling their older tools to the smaller shops, and it was noticeable that the present policy is to clear the floors of old equipment and replace by modern high-grade tools.

American chucks are bought, but the firm makes its own taps and dies, twist drills, and gages. Pratt & Whitney measuring tools are used, and the tool hands work to micrometers. Brown, Boveri & Co. cut most of their own gears, and I understand the firm is able to save about 100 per cent in making its own taps and dies.

The workmen at these shops do not seem to be different in type from those found in the Zurich works, and it is the writer's opinion that the high state of efficiency at Baden is more than ever a case of administrative methods and supervision. I inquired carefully as to how the full possiblilities of some of the American tools in use had been discovered, and learned that in the case of one American firm their representative spent at one time nearly two weeks in the Brown,

FIG. 24.—Simplon tunnel electric locomotive.

Boveri & Co. shops working at the tool which his company supplied. This gentleman demonstrated to the workmen, not simply by a few minutes' talk, but by a fortnight's actual working, just what the tool would do, and it is therefore not surprising that the tool is in high favor. I understand that the Milan agencies are particularly active in reaching the Swiss territory.

CHARACTER AND VARIETY OF OUTPUT.

The Brown, Boveri & Co. works are constructing practically every standard form of electrical apparatus. The firm is also building steam turbines of the Brown-Boveri-Parsons type. The high character of the work turned out, both in electrical apparatus and turbines, may be better understood when it is known that Brown, Boveri & Co.

have installed in Germany, the home of the largest and most advanced electrical manufacturers in Europe, almost as many modern alternate current central stations as have the Germans themselves. The installations of this firm in Switzerland, Austria, Italy, and France are mostly driven by water power, and some of these rank among the largest plants in the world. The firm has developed a special type of generator, with vertical shafts for direct coupling to turbines, and in the Olten-Aarburg central station there is a unique design of a vertical shaft hydro-electric set running at a speed of only 28 revolutions per minute. Among the larger installations is that of the Forces Môtrices du Rhône in Lyons. Provision here was made for a total capacity of 20,000-brake horsepower.

Installations.	Length of transmission line.	Number of alternators installed.	Total output of alternators in PS.	Output per unit in PS.	Report No. 52.			
					Speed in R. P. M.	Phasality and frequency.	Tension at alternator terminals, in volts.	Tension in the transmission line, in volts.
	Km.							
Beznau a d. Aare power station (water)	80	11 a 2	18,200	1,000 36,00	66.6 1,500	b 50—	8,000	27,000
Buenos Aires new power station (steam)	.....	3 3	72,000	12,000	750	b 50— b 25—	12,500	12,500
Cellina (Italian) hydro-electric power station	90	4	10,400	2,600	315	b 42—	4,800	36,000
Löntsch-Werk hydro-electric power station	270	4	24,000	6,000	375	b 50—	8,000	27,000
Paris St. Denis steam power station of the "Metropolitan" underground railway	.....	7 3	90,000	9,000 9,000	750 840	b 25— c 42—	10,500 12,300	10,500 12,300
Piedimulera power station (water)	80	4	11,000	2,750	420	b 42—	8,000	45,000

a Equal steam turbines. b Three-phase. c Two-phase.

THREE-PHASE CURRENTS.

Another important installation, and which at the time was regarded as epoch making, is the Paderno-Milan power-transmission plant. This installation was the first to use three-phase currents of such a high tension as 15,000 volts generated direct in the windings of the generator, thereby avoiding the use of step-up transformers. Generators are built to run both at slow and high speeds. Direct coupling to steam engines necessitates rather slow-speed generators, while the utilization of water power with very high falls calls for generators to run at high speeds. In the Geneva waterworks there is a Brown-Boveri 1,000-horsepower 5,000-volt two-phase motor, direct coupled to a centrifugal pump, which it drives at a speed of 455 revolutions per minute. At the time this motor was installed it was regarded as the largest polyphase induction motor in existence.

The attention paid to developing the three-phase alternating current for railway work places the firm in a position to speak advisedly

[redacted]

ITALY

MACHINE-TOOL TRADE IN ITALY.

INDUSTRIAL DEVELOPMENT IN NORTHERN ITALY.

It is estimated that machine tools to the value of 50,000,000 lire (lira=19.3 cents) were imported into Italy during the period 1905–1907. Germany's share of the business for 1907 amounted to 10,474,800 kilos (kilo=2.2 pounds). These figures will give an idea of the recent enormous demand from the Italian territory, but it should be remembered that this industrial activity was largely confined to northern Italy. Much of the demand came from automobile factories. In the city of Turin alone about 28 such concerns were established, and in the territory comprising Genoa, Milan, and Turin a total in round numbers of 50 automobile factories were started during the period of 1905 to 1907. The administration of the majority of these automobile concerns bordered closely on wild speculation. Purchases of automobile stock apparently became a popular craze, and extended to all classes. Enormous profits only were seen in the automobile business, and instead of being regarded as a luxury the automobile was considered a necessity. In other words, the recent automobile business in northern Italy offers many similar features to the history of bicycle construction in America.[a]

THE FUTURE OF NORTHERN ITALY.

There is probably no section in all Europe that has a greater future than the territory lying on the southern slopes of the Alps. Electric power in great quantity can be made available for the plain country in and around Milan, and the problem of conducting power over long distances is seemingly well understood by the Italians. The best engineers of both Italy and Switzerland are working in conjunction with the industrial leaders of northern Italy, and it is fair to predict that the next ten years will see enormous strides made in the industrial development of this country. Italy possesses her own iron mines, a climate in the northern section wonderfully adapted for industrial work, excellent transportation facilities, and a seaboard close at hand. Northern Italy is in one sense a new country.

[a] The impressions here recorded regarding the northern Italy situation were based on observations during the early part of 1908. Five years previously the writer traversed this same section, and the 1908 inspection enabled him to note the development in the intervening period.

Many Italians declare that Italian history dates from the time of Garibaldi. The Italian leaders are looking to the future, not to the past, and it is their ambition to make of northern Italy a manufacturing section of enormous importance. Italy already has a strong hold on South American trade, and Genoa is the great port from which her manufactured goods are forwarded. These are facts which must be borne in mind is one would rightly understand the present situation, and in considering Italy one must draw a sharp line of demarcation between the north and south. Northern Italy is wide-awake, industrious, and active; southern Italy has yet to be developed.

The great manufacturing sections in northern Italy lie in and around Milan, Turin, and Genoa. The iron mine sections are more to the southward. Until within the last few years Italy has depended on foreign countries for most of her machinery. She hopes to soon reach a stage where she will be independent of the outside world in her requirements for locomotives. The Tosi works at Legnano are turning out as fine a steam engine as is manufactured in Europe. This same firm is building turbines and gas engines, and it is only a question of facilities with the Italian works and not one of knowledge. The facilities are bound to come.

PRESENT CONDITIONS SATISFACTORY—INDUSTRIAL OUTLOOK.

The industrial conditions in northern Italy at this writing (April 27) are good. Last year was the best year in the present decade, and the first quarter of the present is as good as the average showing for the year succeeding. This latter statement is based on the quarterly balance sheets required of all firms on the last day of March. My attention was called to the foregoing by Doctor Pirelli, of Pirelli & Co., Milan, which firm is working 5,300 men. Their outputs are confined to electric submarine cables, land cables, and much of the rubber equipment utilized in automobile construction. The last-mentioned branch of the business has brought this firm in close touch with the automobile industry in Italy, and has placed the representatives of the firm in an excellent position to sum up the present situation.

The view generally entertained among well-informed business men here is that the depression in the automobile business is the natural result of the tremendous speculation which was indulged in. Now that the wealthy classes have been affected by the general shrinkage abroad of securities, it is recognized that automobiles are a luxury. At first buyers of automobile stock could only see enormous dividends, but no account was taken of the cost of advertising, the cost of races, and other expedients resorted to to push sales, all of which expenses increased enormously as new firms came into the market. In well-informed quarters the hope is expressed that eventually the automobile trade will be in better condition.

At least 52 Italian automobile manufacturing firms were organized during the past two years, and of this number about 28 were established in Turin. The small firms have now been crowded back, and in many cases the small shops will take up new lines of industry. This they will be enabled to do by reason of the excellent equipment they possess. Large firms like Isotta-Fraschini and others will, it is thought, continue to hold the field. The larger firms are at present working at a rate equal to about 50 per cent to 65 per cent of the rate demanded by last year's orders, and though the business is relatively quiet such firms are managing to hold their organizations together, and will be in position to take advantage of better times.

Among machinery experts the opinion prevails here that the work on Italian automobiles generally is unexcelled in Europe. My own observations incline me to accept this view, for nowhere have I seen more attention paid to detail than is bestowed by Italian automobile concerns, and my attention has been called to one prominent firm undergoing great expense in order to secure superior results.

The works of Pirelli & Co. are indicative of what the Milan district possesses in a way of industrial establishments. This firm lays submarine cable in all parts of the world. It possesses its own cable-laying vessels, and undertakes not only to lay submarine cables but to maintain but not operate them. This firm provided some of the electric cable utilized in connection with one of the Niagara Falls power plants.

DEMAND FOR AMERICAN MACHINE TOOLS.

The falling off in American machine-tool orders during the past six months may be ascribed largely to the automobile depression. Orders for the automobile factories were abnormal, but those which may be expected now from Italy will be normal. The automobile business has settled down, largely into the control of a few strong firms. The failure of 25 or more small automobile factories has necessarily made available a large number of machine tools. The automobile business requires a high grade of machine tool for the factories, and nearly all of these small Italian firms were stocked up from the beginning with some of the best machine tools obtainable in America. Any falling off in the machine-tool business is only relative when one considers the extraordinary orders of the past two years.

It is only natural that Italian enterprise should hope to secure some of this enormous business in machine tools for its own firms, but at present there are only four Italian firms in a position to do machine-tool work, and one of these, namely, Michele Ansaldi & Co., of Turin, employing 830 men, has been bought outright by the Fabbrica Italiana Automobili, Torino. The remaining firms are Società Offi-

cine Dubosc, Turin; Società Savant, Turin; Società Zug Roberto Züst, Intra Lago Maggiore. The most important of these firms is Dubosc, of Turin. The Züst shops are making a specialty of lathes, and supply a large number of these machines to the Italian arsenals. The machine-tool enterprise of the Züst firm is independent of the automobile works of the same name. The proprietor is the same in both cases, but the automobile shops are located in Milan, whereas the machine-tool establishment is on Lake Maggiore.

NORTH ITALY MANUFACTURING PLANTS.

Milan and Turin may be regarded as the two most important manufacturing centers in northern Italy, but to rightly appreciate the situation one must consider the whole of the southern slope of the Alps as comprising industrial Italy. Manufacturing plants dot this territory in all directions, and there is no line of work, especially in the working of iron and steel to which the Italian does not seem capable of turning. In the works described by the writer only representative plants have been visited, having in mind always the installation of machine tools. The shops visited must therefore be regarded as merely illustrative of the character of the work the Italians have in hand. The installations in these shops will afford a fair idea of the class and grade of tools demanded by the Italians to-day.

The writer's notes on the Italian shops were made during the last few days of April, 1908. The works visited in the Milan district comprised the Breda locomotive shops, Pivelli cable plant, Züst and the Isotta-Fraschini automobile works, and the Franco Tosi machinery establishment at Legnano, a short distance out from Milan.

In Turin the shops inspected comprised the Diatto car plant, Dubosc machine-tool works, "Fiat" automobile shops, and the Michele Ansaldi machinery and machine-tool establishment.

THE MACHINERY WORKS OF FRANCO TOSI, AT LEGNANO.

The foremost machinery works in Italy are those of Franco Tosi, at Legnano. No better steam engines are made in Europe than those turned out by these works. The engineering skill is of the first order, and the exports of the firm extend over Europe and across seas, especially to South America and Egypt. On April 25, 1908, the date of my visit, about 2,000 men were on the pay rolls. The foundry shops are the best I have seen in Europe, with the possible exception of a new foundry building near Düsseldorf. The foundry shop of Tosi is of steel and brick construction throughout, well lighted and equipped with dust-clearing blowers. Most of the machines in use are of German and French make, giving one the impression that American molding-machinery manufacturers have neglected this *plant.* These works are turning out steam engines, gas engines, and

Parsons turbines. Practically all steam engines are of the horizontal type, and those for direct connection to generators are especially designed for central electric stations. Gas engines are turned out up to 700 horsepower, and it is probable the firm will not exceed this power development. These engines are designed to work with suction gas.

The general director of the works is Mr. G. Boner, a man of wide experience and of great engineering ability. He informed me that the South American countries were the principal destinations for exports from the Tosi works. I observed a large Parsons turbine installation on the floors being made ready for shipment to Buenos Ayres, and a 3,000-horsepower steam engine for Montevideo. Lentz valve gear is being manufactured, but under modifications.

AMERICAN TOOLS USED.

The following American machine tools are in service:

Gisholt Machine Company, Madison, Wis., lathes and boring mill; Brown & Sharpe Manufacturing Company, Providence, R. I., millers and grinders; Hendey-Norton Company, Torrington, Conn., shapers; Lodge & Shipley Machine Tool Company, Cincinnati, Ohio, engine lathe; William Sellars & Co., Philadelphia, Pa., planer; Cleveland Automatic Machine Company, Cleveland, Ohio, automatic turret machine; Niles-Bement-Pond, New York, lathe and planer; Becker-Brainard Company, Hyde Park, Mass., millers; Baush Machine Tool Company, Springfield, Mass., vertical drills; Jones & Lamson Machine Company, Springfield, Vt., turret lathes; and Gould & Eberhardt, Newark, N. J., drills. Still other American firms represented are: Pratt & Whitney, Hartford Conn., American Tool and Machine Company, Boston, Mass

The English makers are represented by Kendall & Gent, of Manchester. The German makers were represented by Collet & Engelhardt; Reinecker, and Deutsche-Niles. The Swiss shops were represented, as was also Dubosc, of Turin, Italy. In addition to the foregoing there were a number of special tools on the floor, the make of the Tosi works.

NEGLECT OF AMERICAN MANUFACTURERS.

The general director informed me that for heavy, rough work the German tools sufficed, and that the demand for the American tools is limited to special machines where great accuracy is required. I was given to understand that it is the policy of this firm to gradually replace all old tools with modern equipment, and a firm that is as go ahead as this one will quickly recognize the advantages of a fine tool when attention is called to it. The men who are at the head of the Tosi establishment are endeavoring to make it a greater plant than at present. They are progressive, and welcome new ideas.

The only fault found at the Tosi works with any American machine tools was with one of our American-made engine lathes. The plat-

rest was criticised. I pointed out that the particular tool criticised was of an old type, and that the firm in question was turning out at present a high-grade engine lathe especially designed for the European market. This firm would do well to have one of its representatives show its new engine lathes at the Tosi works.

CHARACTER OF WORK.

The work on the Parsons turbines, as turned out from these shops, is of first-class order, and my attention was attracted by finding that the worm gear for driving governor and oil pumps on the shafts is milled and not turned down on lathes. Reinecker millers are employed for this purpose. The general director stated that it was the experience of his firm that the steam consumption for a 2,000-kilowatt Parsons installation is more economical than a reciprocating engine for the same power. This statement covers only the larger powers, and does not hold good below 2,000 kilowatts. A type of superheater, the design of the firm, is made here. The works were running full time and very busy. Every tool was in operation. The shops are located in the town of Legnano, distant by electric railway about twenty-five minutes' ride from Milan. The climate in this section is extraordinarily well adapted to industrial work, and the proximity of the Alps, with the immense power available from the streams of that region, promises to make Legnano a still greater industrial center. At present about 40,000 horsepower is conveyed from the Alps to works in and around this place.

PAY AND TREATMENT OF WORKMEN.

A few of the most expert men receive as high as 11 francs per day ($2.12), but only a very few, and the pay of a shop foreman is but little more. This is considered very good pay in Italy. For the majority of the men the pay ranges from 8 to 10 francs per diem ($1.54 to $1.93), with about 6 francs ($1.16) per day for the younger and less experienced employees.

The Tosi works do much for their workmen, and the firm name is respected and honored throughout the north of Italy. The educational advantages in the small villages of Italy are practically nil. This firm makes a practice of educating the boys of its workmen. Five schoolmasters were engaged in instructing about 100 boys. These schoolmasters are employed by the firm, and an excellent building has been set apart for a schoolhouse. There is a fine large playground, and the equipment of the school would do credit to many of our municipal schoolhouses. The discipline is rigid. It was explained to me that the aim of the firm is to give the boys a good general education, having in view always that they will succeed their

fathers and become skilled and intelligent mechanics. The boys are taken into the schools when about 8 years of age, and continue there until they become 14. Mr. Tosi, the son of the founder, entered this school as a lad, and knows by personal experience its merits. After the boys have reached 14 years of age they are placed in the shops as apprentices, and for several years continue at stated periods in night school. These advantages offered by the firm were absolutely necessary in order to provide for that establishment intelligent workmen. The studies pursued in the school comprise arithmetic, history, elementary physics, hygiene, and drawing.

THE BREDA LOCOMOTIVE WORKS, MILAN.

AMERICAN MACHINE TOOLS IN SERVICE.

The Italian locomotive works, known as Società Italiana Ernesto Breda, Milan, were, when visited April 27, 1908, working about 4,500 men. The figures here quoted were stated by the firm. The Breda shops are among the very best in Italy in point of administration and good workmanship. Of the 4,500 men employed by Breda, about 2,000 are working in the locomotive department at Città. Breda is turning out a new high-speed type of passenger locomotive, designed for a speed of 120 kilometers per hour. It is a beautiful machine, compact, and solid in construction. There are four cylinders, working compound, operating four cranks. The compounding is independent for each side. Superheating is not used. About 40 of these engines have already been turned out for the Italian state railways. Krupp and Bochum furnish practically all the wheels and axles used. Copper fire boxes and copper stay bolts are the rule at Breda's as well as in German shops. The Ingersoll pneumatic tools of America are in service in the boiler shops. Here, as in the German works, one is impressed with the great amount of unnecessary work on machine parts. What is deemed as largely unnecessary work on machine parts is, however, prescribed in the specifications of the Railway Directory. The designs, it must be known, generally emanate from the state engineers. Breda has at present about 120 locomotives of large size under construction. The speed of the shops is fast, and in respect of high tool speed is very American in management.

FRENCH INSPECTION METHODS—BORING TOOLS.

I find that the Breda people have had the usual experience of other firms when building locomotives for France. There seems to be a general complaint throughout foreign shops that the French inspection methods are unnecessarily close. I am informed that one firm had some boiler work rejected because some of the rivet heads showed

an excess of 1 millimeter in compression. In other words, the rivet heads should have been flattened down 1 millimeter more to meet requirements. I understand that the French ministry, however, accepted the work.

Breda bores all six cylinders of the new passenger locomotives simultaneously. He makes his own boring tools and turns out a gang of horizontal borers designed, as above stated, to take the two high-pressure, two low-pressure, and piston-valve cylinders simultaneously. Practically all milling is performed by tools of this firm's make. I did not see a Reinecker miller in the shops, and in fact there were very few German tools of any make present. De Fries has installed a few tools, but even the de Fries machines are of American origin. Breda is operating about 40 large milling machines of his own construction. The foundry shop is turning out good work. The building itself has little to commend it, but the men seem to know their business. Cylinder combinations are readily made in one casting. Only plate frame form of construction is used, and the steel comes both from Germany and Italy.

The painting and finish work on the locomotives is very fine. No less than 12 applications of paint and varnish, following filling, are made. The filling, varnish, and paint and number of applications are all fully prescribed by the state engineers in the specifications. Most of the finishing-off work is performed by hand, and the writer saw some hand work done here which reminded him very closely of the work required on high-finished wood for the living quarters of some ships.

AMERICAN AND OTHER TOOLS IN USE.

There is a dearth of grinding tools at Breda's, and in this respect the Italian shops are not abreast of some of the best German locomotive installations. Gisholt has at least six turret lathes installed, and the machines are well liked. There is room here for more milling machines of the type turned out by Browne & Sharpe, Cincinnati Milling Machine Company, Becker Milling Machine Company, and others. The last-named firm, however, is represented.

The following manufacturers of American machine tools have machines installed at the Breda works:

The Ingersoll Milling Machine Company, Rockford, Ill.; Cleveland Automatic Machine Company, Cleveland, Ohio; The Acme Machinery Company, Cleveland, Ohio; Niles Tool Works, Hamilton, Ohio; Bickford Drill and Tool Company, Cincinnati, Ohio; American Tool Works Company, Cincinnati, Ohio; Baush Machine Tool Company, Springfield, Mass.; American Planer Company, Cincinnati, Ohio; William Powell Planer Company, Worcester, Mass.; Gould & Eberhardt, Newark, N. J.; G. A. Gray Company, Cincinnati, Ohio; Jones & Lamson Machine Company, Springfield, Vt.; Prentice Brothers Company, Worcester, Mass.; Lodge & Shipley Machine Tool Company, Cincinnati, Ohio;

Becker-Brainard Company, Hyde Park, Mass.; Garvin Machine Company, New York; Schumacher & Boyl, Cincinnati, Ohio; George Gorton Machine Company, Racine, Wis.; The Bradford Machine Tool Company, Cincinnati, Ohio; Hamilton Machine Tool Company, Hamilton, Ohio; Bement-Miles Company, Philadelphia, Pa.; Putnam Machine Company, Fitchburg, Mass.; F. E. Reed Company, Worcester, Mass.; Landis Tool Company, Waynesboro, Pa.; Hendey Machine Company, Torrington, Conn.; Mitts & Merrill, Saginaw, Mich.; The W. P. Davis Machine Company, Rochester, N. Y.; The Pond Machine Tool Company, Plainfield, N. J.

German makers are represented by the Chemnitzer Werkzeugmaschinenfabrik; de Fries & Co.; Ernst Schiess. From the last-named firm there were only a couple of tools in service. English makers were represented by Smith & Coventry, Kendall & Gent, and by Massey. Italian firms were represented by Dubosc, of Turin; Züst, of Lake Maggiore; and by Macchix Passoni, which last firm furnishes metal cutters. Beside the millers in service of Breda's own design I observed about 10 metal-cutting machines at work, all of Breda's design and construction.

EQUIPMENT OF ITALIAN SHOPS.

The Breda firm, while not a new one, is representative of modern and progressive Italy. The workmen at Breda's receive about 40 centimes per hour on an average throughout the year. A working day is ten hours. The men are working fast, and there is a care and attention bestowed on the locomotive work which is almost in keeping with some of the best work I have seen in the automobile shops. The usual steam pressure seems to be 16 atmospheres for the new high-speed locomotives. No superheaters are used, as a rule, although Schmidt superheaters are presented for several designs. Breda builds almost entirely for Italy, as the firm finds it difficult to compete abroad with the Germans. A few Breda locomotives, however, have been built for Denmark and Roumania.

The Città shops are mostly old and not well lighted, although there is one new shop of excellent design. This latter shop is used for boiler work. The Città works are located in the city and are not far distant from the main railway station. Their situation is in this respect similar to that of Baldwin's of Philadelphia.

ROOM FOR AMERICAN TOOLS.

All the plate frames at Breda's are worked with triple slotting machines. I observed no oxygen-gas cutters or hydraulic presses in use for stamping out frame parts, such as I reported finding in the best German shops. The machining work at Breda's on engine parts seems to be the best feature of the establishment. The boiler work is good, and the general finish on engines is of an exceptionally high order. There is room, however, at this plant for many of our best tools, and this fact should be taken notice of by those of our manu-

facturers whose names are not included in the list given above. Even in the case of several of the firms already represented it would be well if expert men could visit these shops and show the workmen some of the wrinkles which can be got out of the tools. I mentioned in a previous report how one American tool stood in a Swiss shop for many months and was practically neglected because it was not understood. An expert man visited the shops, and finding the neglect of this tool which he represented, obtained permission to work in the shops for a couple of weeks, and in that time so enlightened all hands that the result was an order immediately for an additional tool and an order for two more of the same type going forward. This particular tool reduced the cost of work as it had been performed on some foreign tools by 80 per cent.

Breda is supplied with several hydraulic presses, one of 2,000 tons furnished by Fielding & Platt, and one of 350 tons furnished by Haniel & Lueg, of Düsseldorf. In addition, there are hydraulic presses for axle and wheel work.

THE ISOTTA-FRASCHINI WORKS, MILAN.

The Isotta-Fraschini automobile works in Milan were working at the time of my visit, April 25, 1908, about 700 men. The installation of machine tools is one of the best I have seen in Europe. It may be estimated roughly that there are 400 machine tools in service on the floors, and that at least 70 per cent are American. It was indicated that the great majority of these tools were purchased during the past two years. The plant is at present working about 50 per cent as many men as during the recent busiest time. The following makes of American machine tools are installed here:

Brown & Sharpe Manufacturing Company, millers and grinders; Potter & Johnston Machine Company, automatic turret chucking and turning machines; machines from the Gridley Automatic and Windsor Machine Tool Company; Lodge & Shipley and Lucas Machine Tool Company, engine lathes; Cincinnati Milling Machine Company and Becker-Brainard Milling Machine Company, millers; Warner & Swasey, hexagonal turret lathes; Baush Machine Tool Company, boring mills; Cincinnati Shaper Company, shapers; Gleason Works, gear planers; Pratt & Whitney, lathes; Cincinnati Machine Tool Company, drill presses; Bickford Drill and Tool Company, drills; Landis Tool Company and Norton Grinding Company, grinders; Baker Brothers and Hendey-Norton Company, shapers. There were also some Cleveland make automatic screw-working machines.

German manufacturers are represented by the Wanderer Works of Chemnitz, Deutsche-Niles, Phœnix, Reinecker, Grafenstaden, Gebr. Bohringer, and Mayer & Schmidt. The Wanderer Works supplied millers, and Reinecker installed shapers built by him on the Hugo Bilgram, Philadelphia, designs. Mayer & Schmidt supplied grinders, Grafenstaden drills, and Bohringer boring mills. The only English tools observed were several turret lathes from Herbert, of Coventry. The French were represented by H. Ernault, of Paris, and there was a large installation of Ernault boring mills for use on cylinder work.

WAGES AND LIVING CONDITIONS—MODERN EQUIPMENT.

The Isotta-Fraschini works are paying tool men between 45 and 50 centimes (100 centimes=1 franc=19.3 cents) per hour on a ten hour per day basis. An operator working at a Herbert turret lathe when questioned in my presence as to his pay exhibited a ring job on which he was engaged, and said he is able to finish about 15 of these rings per day. For each ring he received 45 centimes, which would mean 6.75 francs for a day's work. This rate of pay from an American viewpoint is extremely low. The work was well finished, but the speed was very much below what is seen in American shops. One of the officials at the establishment informed me that his chauffeur, who worked hard at the shops during the day, was able to satisfy himself on a dinner in the near-by restaurant costing 60 centimes. This included no meat except, perhaps, a small quantity of sausage. Many of the Isotta-Fraschini workmen, it was said, did not know the taste of a beefsteak. The organization at this establishment, however, is a fine one. The work is carefully done, the attention to detail is painstaking, and with the magnificent equipment possessed this plant only needs speed to earn a high percentage of efficiency.

About 75 per cent of the Isotta-Fraschini outputs are for export, and it was stated that the falling off of orders from the United States during the past year had been felt by this firm.

The present Isotta-Fraschini shops are modern throughout. They were put up in 1905, and practically all the tools now in service were purchased subsequent to the opening of the new shops. All tools installed in this plant are arranged in groups and fenced off, the millers in one group, the lathes in another, the boring machines by themselves, the automatics together, and so on.

MORE INFORMATION NEEDED.

The statement was made by an official that when a new tool is received from America about all the information they had was what could be gleaned from a printed description in English, and that the shop expressions greatly puzzled them in translating. The writer is convinced that many of the tools at these shops are not working at the capacity they are designed for, and that this state of affairs is due to ignorance of the full capabilities of the tools. There are several agencies in Europe having American operators attached, but the agency that is simply doing a commission business on a correspondence basis is generally able to give little information. There are differences between selling goods in the United States and selling goods in Europe, but the differences are not so great as some of our manufacturers believe. It is a question of reaching the shops and

getting in touch with the men who actually buy and use the tools. These men want information. They are open to new ideas, and can be made to appreciate a new tool when offered by a practical man. The writer has visited machine shops as far north as Stockholm and as far south as Genoa, and involving nearly every country in Europe, and he strongly deprecates the idea that a foreigner can not be reached except by a man of his own country.

AMERICAN MANUFACTURERS SHOULD VISIT FOREIGN WORKS.

What is needed is a better acquaintance between the heads of the European plants and our American manufacturers. It is the men who are holding positions as directors in many of our leading works who should take the time to get acquainted abroad. There are many of our directors who have worked themselves up from the bottom and who know the practical as well as the commercial end. Such men, experienced in business affairs, will soon size up the situation in Europe if they will take the time to get out among the shops, in other words, do their investigating on their own account. Once our manufacturers thoroughly understand the situation they are in position to act intelligently, and they will appreciate what agencies have to contend with. To pass judgment on a subject of this kind requires experience. It also means time and the services of a valuable man.

FUTURE CALL FOR TOOLS—OUTPUT—FRENCH STEEL.

The Isotta-Fraschini works are one of the few firms which have weathered the recent automobile depression in Italy. This establishment is at present well stocked up with machine tools. It is turning out engines ranging up to 65 horsepower, and for racing machines to still higher powers. The steel used in the frame construction is drawn both from Italian and French sources, but the greater part comes from France. The opinion seems to prevail here that the French are making the best steel for automobile purposes and that it possesses the strength and lightness essential to a remarkable degree.

THE ZÜST WORKS, MILAN.

The shop equipment of the Züst automobile works at Milan is of high order. About 70 per cent of the tools installed are of American make. The buildings are practically new, and the main shop is constructed of steel and concrete. The greater part of the flooring consists of small tree sections driven into the ground for a distance of about 2 feet. The machine tools stand on cement beds.

The business at the Züst shops (April 24) was practically at a standstill. From Mr. Robert Züst I learned that the necessary parts are in stock just now to admit of the assembling of about 200

machines. This firm makes only 50-horsepower engines, and every engine is carefully tested in the laboratory shop before issued. I witnessed the speeding up of one of these Züst engines on the electric brake machine. A speed of about 1,300 revolutions per minute was recorded, yielding about 63 horsepower. This power of course could not be obtained practically, though I understand that these Züst engines will readily work up to 50 horsepower on the road.

The work required on these automobile engines is of a very careful and painstaking sort, and it is evident at the Züst shops that an extraordinary amount of attention is paid to detail. The machine work on the engines is of an exacting character, and this explains the necessity for high-grade machine tools.

DECREASING NUMBER OF MOTOR WORKS.

The Züst shops in Milan are devoted only to automobile construction, and are independent of the machine-tool house of the same name at Lake Maggiore. The ownership, however, is the same. The Züst shops seem to have weathered the recent depression in the automobile business and may be expected to continue work. Of the 50 automobile concerns which sprang into existence in Italy during the past three years not more than ten or twelve, it is thought, will survive, and in some quarters it is doubted if at the end of the year there will be more than six or seven Italian automobile firms in the field.

Many tools at the Züst shops were found idle and covered up, while there appeared to be many new shipments on the floors still unopened. A little over a year ago at this time automobile makers were willing to pay high rates of advance for immediate delivery of tools. Among the American machine tools found in the Züst shops were observed standard-type machines stamped Brown & Sharpe Manufacturing Company, Hendey-Norton, Becker-Brainard Milling Machine Company, Cincinnati Milling Machine Company, and Jones & Lamson Machine Company.

The German makes represented were mostly from the Reinecker shops, of Chemnitz, and the Deutsche-Niles works. The Züst shops are operating only a few machines, and while only barely running, this establishment is in a position to take advantage of the market when conditions improve. The fact that the Züst works have been able to pull through the recent period of depression attests strongly to the strength of the establishment.

THE DIATTO CAR WORKS.

The Diatto works at Turin were working (April 29) about 1,200 men. This firm is engaged in the construction of passenger and sleeping cars and cars for special express goods and truck Practi

cally all the cars turned out by this firm are for orders of the Italian state railways. There are very few American machine tools in use at this establishment. W. E. Gang & Co., of Cincinnati, Ohio, have a drill press in service, and there are some Millers Falls pipe cutters in use, as were also some of our American pneumatic tools. In an inspection of the Diatto shops the foregoing comprised all the American equipment observable. This firm is drawing on the United States, however, for much of the pine that it uses in car construction. Russia and Austria supply some woods and the teak used comes from Siam.

The Diatto firm is turning out a standard continental type of sleeping cars for about 100,000 lire ($19,300). The cars built by this firm are of high finish, and are practically as good as any turned out in Europe. When more Diatto cars are in service second-class travel in Italy will be fully as good as in Germany. It is the writer's opinion that this firm has been overlooked by many of our machine-tool houses. The car equipment, involving axles and wheels, comes mostly from Germany. A considerable quantity of Italian plate framing is used, and Westinghouse air brakes are exclusively employed. There are no special designs in construction, and the interest at this firm largely centers in the fact that the Italians are developing this form of industrial work, and at the present rate of progress it will not be many years before Italy is practically independent of foreign countries for both locomotives and railway carriages. The Diatto works in Turin and the Silvestri shops in Milan are both capable of the best work demanded on railway carriages.

THE DUBOSC MACHINE-TOOL WORKS, AT TURIN.

The Società Officine Dubosc is the one Italian machine-tool house which may be expected during the next few years to command a good share of the machine-tool business in Italy. The firm is not a new one, but within the last few months it has completed the erection of fine new shops and has undertaken the installation of essentially modern equipment. President Fasola heads the firm, with General Director Edmondo Dubosc in direct charge of administration. Mr. Edgar Dubosc is charged with the technical control of the works. The new shops were built within the past year and have been occupied only within the last three months. It is the writer's opinion that the Dubosc shops will become an important factor in Italian industrial development. The firm was working April 28, 1908, about 200 men and has all the orders, I was informed, that it can handle. It is turning out a special bevel-gear cutting tool, and has already sold five of these tools in England and three in Germany.

CONSTRUCTION AND EQUIPMENT.

The new shop buildings are of concrete construction, modern in every way, and as light inside as out of doors. The Dubosc works are manufacturing lathes, milling machines, shaping machines, drill presses, gear cutters, and boring machines. All castings come from the Turin foundries. The following American machine tools were found in service there:

Bickford Drill and Tool Company and W. F. & J. Barnes Company, drills; Kempsmith Manufacturing Company and Becker-Brainard Milling Machine Company, millers; Cincinnati Machine Tool Company, drill presses; Brown & Sharpe Manufacturing Company and Gould & Eberhardt, gear cutters; Niles Tool Company, horizontal boring mill; Flather & Co., Lodge & Shipley Machine Tool Company, Hendey Machine Company, Pratt & Whitney, Van Wyck Machine Tool Company, lathes; Landis Tool Company, the Washburn Shops, and Cincinnati Milling Machine Company, grinders; Jones & Lamson Machine Company, turret lathes; Millers Falls Company, pipe cutters; Cincinnati Shaper Company, shapers.

The German makers are represented by Reinecker, Bohringer, and Herman Pfanter. There was some criticism regarding the accuracy of the adjustments on the Bohringer planers, especially round the slide box and face plate of cutters. The English makers are represented by the firms of Alfred Herbert (Limited), by Richards, and also by Wolseley.

TOOL PRICES—HEAVY ITALIAN PURCHASES.

Some of the prices paid for tools installed at the Dubosc works were, in lire (1 lira=19.3 cents), approximately, as follows:

Böhringer, planer, 3 meters table, 6,640; Böhringer, planer, 7 meters table, 23,144; Cincinnati Machine Tool Company, drill, 17 inches between column and drill, 3,000; Biernatzki & Co., Chemnitz, gear cutters, 26 inches, 5,271; Dubosc engine lathe of same size as Lodge & Shipley, 2,900; Lodge & Shipley, engine lathe, 4,000; Hendey Machine Company, lathe, 16 inches by 8 inches, 3,375; Landis Tool Company, grinder, 7,388; Herbert (England), No. 16 combination turret lathe, 19,135; Jones & Lamson, turret lathe (the Herbert No. 4 lathe corresponds to the Jones & Lamson turret lathe), 7,894; Reinecker lathe, 6 meters swing, 7,100.

Dubosc has at present orders for 110 lathes and 24 shapers, and the work is being gotten out as rapidly as the shop facilities will permit. All castings of cast iron for the machine tools come from the Turin foundries.

In view of the statement that in the period since 1905 foreign machine tools were purchased by Italian industrial firms to the extent of 50,000,000 lire, or approximately $10,000,000, it is no wonder that the Italian machine-tool houses believe that they should have some

share of this business, and it is for this reason that the fine new shops of the Dubosc works have been erected. The entire scheme of the new plant contemplates extensions of the property and additions to the present equipment.

GEAR CUTTERS AND ENGINE LATHES.

I find that the bevel-gear cutter, as turned out by this firm, can cut to 750 millimeters and gear 1 to 7. This gear cutter is described in a special report. Some criticism was made of the indexing of the gear cutters of one of our standard American machines, the opinion being expressed that our indexing was a little too delicate, and that when the speed is rapid the indexing does not properly function. This criticism applied to the tools of one maker, whereas the indexing of the tools of another American maker was well spoken of.

The Dubosc engine lathes are carrying their regulating spindle under the cones and not exposed, as in the case of the majority of lathes. This arrangement makes a very strong and compact-looking machine and eliminates all danger due to exposure. Some of our engine-lathe makers cover this exposed gearing.

The Dubosc engine lathe is just a trifle larger than the standard Lodge & Shipley. The Italian firm is selling its lathe at the shop for about 3,000 francs, or $600. The Dubosc lathe is provided with ten speeds.

It was observed that Dubosc is using Reinecker lathes to turn down spindles. There was some complaint made about the countershafting as supplied with an American grinder being too heavy. The writer merely notes these criticisms and remarks for the benefit of our manufacturers. It is his own opinion that the countershafting is none too heavy, but this fact has to be pointed out and explanations made often as to the reasons for our designs. The Reinecker engine lathes at Dubosc's have a swing of 6 meters, and it is stated that the price paid was about 7,000 francs each.

LATHE-WORK COMPARISONS.

The English turret lathes are liked here because of their rather heavy proportions. Some American turret lathes do appear a trifle light in close comparison, but I have not heretofore heard complaints of them because of lack of metal. This refers more especially to the Jones & Lamson lathe. The majority of the foreign shopmen recognize that not only in this particular tool, but in others, the proportion of metal with due regard to stress has been very carefully studied out, and that our manufacturers are not throwing away any metal and adding unnecessary weight. Most of the criticisms which I have heard advanced in foreign shops against American machine-tool

features can readily be answered, but the main point is to have the shops covered and see to it that foreign competitors do not magnify some of these trivial complaints or criticisms into formidable objections. As indicated in a recent report, American machine-tool manufacturers need an export organization in Europe, and when such an organization is established for the benefit of machine-tool makers it will be possible to meet competitive tactics. As a rule, agencies are unequal to it.

Dubosc is paying the operator at a Jones & Lamson lathe 30 centimes per hour. A man at a Herbert lathe, working alongside a Jones & Lamson, is receiving 36 centimes per hour. These men are working on piecework. The Jones & Lamson lathe man was turning up handles for new Dubosc lathes. The tool man at the Hendey-Norton lathe was making a lot of small rings for lathe construction and was receiving 40 centimes per hour. The Herbert lathe was turning out cones and pulleys for Dubosc lathes. The Jones & Lamson tool man was turning down a lathe handle in twelve minutes; the same job, Mr. Dubosc said, required two hours on an ordinary lathe. Some of the lathe hands at Dubosc's when working on difficult parts receive 60 centimes per hour. The man at the Reinecker lathe turning down spindles receives 60 centimes per hour. The shop chief receives 10 francs per day, and the assembling men 60 centimes per hour. Dubosc has 200 men now at work and is constantly adding to his force.

BEVEL-GEAR SHAPERS.

Dubosc is manufacturing at present a special type of bevel-gear shaping machine. The machine is much improved over early issues, and the firm is receiving orders for it both from England and Germany. It is heavy and stoutly constructed. The drive is by belt with a single belt pulley driving a friction shaft. Heavy cuts can be taken in alternate directions, in which case a double tool can be employed and cutting effected on both strokes. The blank is rotated only to effect the division, and the forming of the teeth is effected wholly by the tool movement. The cross shaft supports a locking plate, having one hole in it into which a spring plunger enters. One revolution of the plate is necessary for all divisions.

The tool holder is subjected to two successive deplacements. There is a vertical shaft which is fixed and around which a primary bracket turns, carrying a horizontal shaft perpendicular to the first and meeting in a point which will be the summit of the cone, which at the same time is the center of all fictitious spheres; a second bracket on which the tool holder is fixed turns around the horizontal shaft. It will be gathered that if the point of the tool is fixed at a certain distance from the summit the angular deplacements of the first

bracket will move this point and cause it to describe what might be called an equatorial circle, while the deplacements effected by the second bracket will describe the meridians of a sphere.

Supposing now on the line of the equator a series of equal elementary deplacements, and further suppose that to these abscissas correspond variations of ordinates on the meridian, these variations

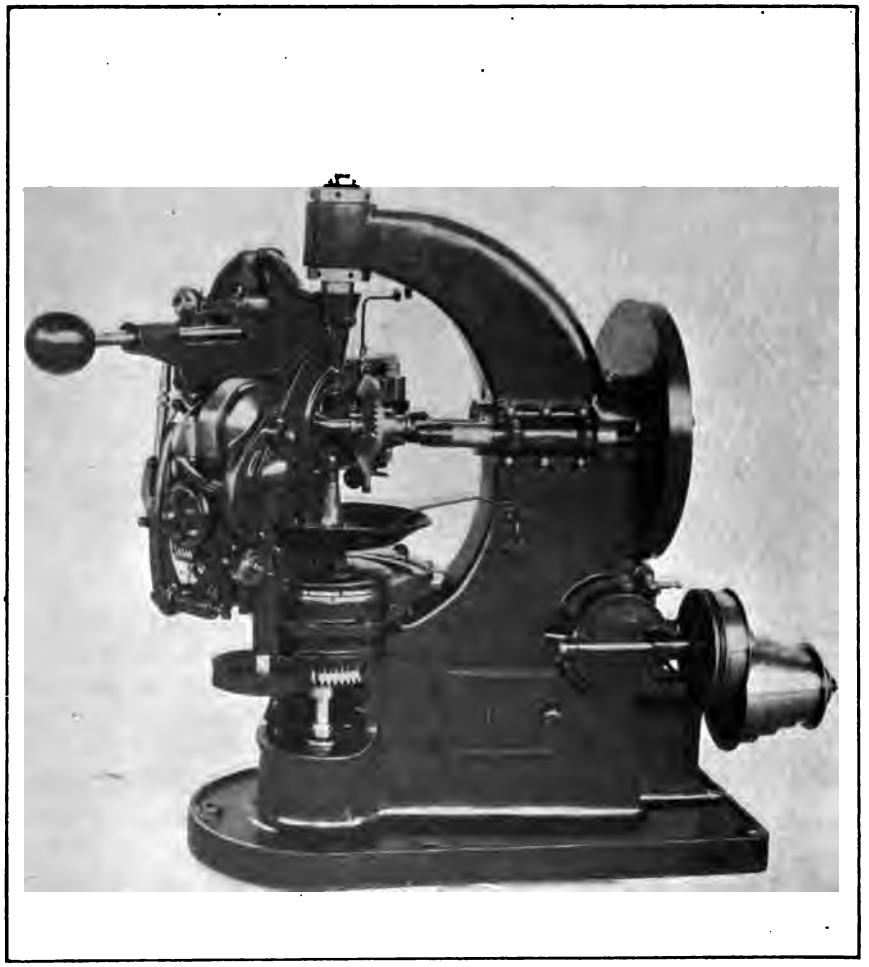

FIG. 26. Dubose bevel-gear shaper.

being equal, the lines described by the point will be great circles and the trace produced will correspond to the forward and backward motions. If the variations of ordinates are unequal the point will trace on the sphere a curve which is not a great circle, and the alternate forward and backward movement will produce a conical surface of which that curve will be the directrix. Supposing the directrix

be an arc of development of circle and precisely the arc of spherical development, which it is possible to cut for the wheel placed in the way that the median trace of the tooth to be cut coincides with the equatorial trace of the sphere, the point of the tool will then produce one side of the tooth.

MATHEMATICAL PRECISION IN CUTTING WHEELS.

The basis on which this new machine is designed for cutting a conical-tooth wheel without recourse to gage assumes that the tooth cone is finally determined by the angle of the summit : : 2a and the number of teeth Z; taking as a fundamental taper or division (1) the one which corresponds to a sphere of 1,000 mm. of radius:

$$M = \frac{2{,}000 \sin a}{Z}$$

Knowing the taper or division "m" measured on the primitive diameter on the back of the tooth and the distance "d" from the extremities of this diameter to the summit of the cone there results the following:

$$m = \frac{2\ d \sin a}{z}$$

wherefore the fundamental taper or division equals

$$\frac{1{,}000 \times \text{module of the tooth}}{d.}$$

It should be remembered that the module taper or diametrical division is obtained in millimeters by dividing the primitive diameter by the number of teeth, and it follows from the foregoing that the systems of deplacements of the two brackets must be connected by a mechanism so adjusted that the point of the tool describes on the sphere a 1,000 mm. radius, the curve of development necessary for the tooth. The name which Dubosc has given to this feature of mechanism is "galbigene."

The tool slide for this Dubosc tool, one observes, is mounted on a stiff frame. The frame pivots about the vertical axle. The tool, however, can only cut one side of the tooth at one setting. The blank therefore makes first one revolution when all the teeth are machined on one side. A readjustment of the tool is necessary to permit of cutting the teeth on the opposite side. The motion from the drive pulley is taken across the machine to change wheel and thence to the worm. A very large diameter driving wheel is employed and a ball resembling the form used on governors is used to balance the slide. This slide, as has been indicated, has a motion in a vertical plane for taper with a second adjustment in this same plane to permit of any peculiarities in taper.

The Dubosc bevel-gear shaper is well spoken of, and the indications are that this firm will receive substantial orders for the design.

THE "FIAT" AUTOMOBILE WORKS, AT TURIN.

The automobile shops at Turin known as Fabbrica-Italiana-Automobili-Torino ("Fiat") were working on the occasion of my visit, April 29, 1908, about 800 men. This is one of the most progressive shops in Italy. The head of the establishment is Director-General Cav. Giovanni Agnelli. Inspection of the works disclosed a superb installation of up-to-date American machine tools. There are more than 500 machine tools on the floors, and of this number over 350 are of American make. The balance were purchased from Italian, French, German, British, and Belgian firms. Nearly all the machines in service were bought during the past three years.

The superlative in attention to detail and finish is almost attained at these works, and great care is bestowed in the manufacture of engine parts. Italian workmen are proving very apt with American machine tools, but it is a curious fact that the majority of Italian machinists soon tire of a tool. Director-General Agnelli informed me that a day seldom passed when some workman did not ask to be transferred to a new machine. Arguments were of no avail. Even when it was pointed out that the transfer would involve a reduction in pay it made no difference with the men. Apparently this characteristic is one of temperament, and I have frequently heard it remarked by those in charge of Italian workmen that the men must be given a change of interest. This is the only drawback observed in the Italian shops, and it is rather a serious one, since it means often the loss of a good tool man just when he is becoming proficient.

OPERATIVES AND WAGES.

At a group of Jones & Lamson turret lathes three tool hands, each working his own machine, were questioned in my presence as to wages earned. One man replied 37 centimes (7 cents) per hour, the second 38 centimes ($7\frac{1}{3}$ cents) per hour, and the third 34 centimes ($6\frac{1}{2}$ cents) per hour. A working day at the shops comprises ten hours.

All gear boxes are of aluminum construction. Men doing handwork in finishing off these gear boxes, when questioned, replied that they were receiving 35 centimes ($6\frac{3}{4}$ cents) per hour. One man working at a Gleason gear cutter stated that he was receiving 35 centimes per hour.

The Potter & Johnson automatic turret chucking and turning machines installed here were bought direct from America, I am informed, and not through any agencies. One of the best of the workmen

at the Potter & Johnston group of tools was turning out differential pinion clutch work, having a diameter of 136.7 millimeters (approximately 5.39 inches), with a spindle diameter of 56 millimeters (2.2 inches). The work was of a highly finished character. This man stated he was receiving 38 centimes (7⅓ cents) per hour. He was able to turn out about five of these clutches per day, or about one every two hours.

The workman at a Bickford drill stated that he was receiving 34 centimes (6½ cents) per hour. No fault was found with this tool. Some complaint was made, however, regarding the measurements on the index rod of one American tool. It is claimed that the indexing was out about one-sixteenth of a millimeter (millimeter=0.0394 inch).[a] I found Prentice Brothers Company tools in use boring out gear boxes, and planers of G. A. Gray Company, of Cincinnati, were doing practically all the planing work on the gear boxes. The gear-planer men were receiving on an average 45 centimes (8⅔ cents) per hour.

PRESENCE OF FOREIGN TOOLS.

Deutsche-Niles vertical boring machines were present in considerable numbers, as were also the boring tools of Ernault, of Paris. I found one of these French boring mills doing all the boring work required on a gear box, as well as boring out cylinders, and one man working one of these French machines was receiving 50 centimes (9⅔ cents) per hour.

The question of prices paid for American and foreign machine tools has long been one of conjecture among machine-tool manufacturers. Why this has been the case has always puzzled the writer. As I have pointed out repeatedly in former reports, our American manufacturers will learn much to their advantage if they will make it a point to get more in touch with the men who are at the head of industrial works where machine tools are used. The "Fiat" shops, for example, were so much pressed during the past two years that frequently there was no objection to paying premiums on machine tools. This establishment paid in all for the machine tools now installed 2,408,176 lire ($464,778). The total number of machine tools, inclusive of pumps, in these works is 649. Of this number 516 were purchased prior to 1907 and 133 during and subsequent to that year. The total price paid for tools purchased in 1907 amounted to 726,199 lire (lira=19.3 cents).

[a] This criticism was made the subject of a special report to the Department for transmission through the Bureau for the information of the firm concerned.

I am advised by the managers of this establishment that the prices paid for some of these tools were as follows (values in lire, 1 lira=19.3 cents):

Name.	Type and number.	Total cost.
		Lire.
American Tool Works Co., Cincinnati, Ohio	Drills, 8	6,235
Do	Lathes, 6	14,228
The Bradford Machine Tool Co., Cincinnati, Ohio	Drills, 6	12,650
Do	Drill, 1	2,137
Becker-Brainard Milling Machine Co., Hdye Park, Mass	Millers, 4	15,850
Hugo Bilgram, Philadelphia, Pa	Gear cutters, 5	46,750
Do	Gear cutters, 2	15,800
E. W. Bliss & Co., Brooklyn and St. Ouen (Paris)	Press, 1	3,000
Brown & Sharpe Manufacturing Co., Providence, R. I	Millers, 4	20,982
Do	Miller, 1	5,250
Do	Grinders, 3	10,525
Dresses Machine Tool Co., Cincinnati, Ohio	Drills, 7	18,923
Cincinnati Milling Machine Co., Cincinnati, Ohio	Millers, 9	43,500
Do	Miller, 1	4,975
Cleveland Automatic Machine Co., Cleveland, Ohio	Automatic turret machines, 3	22,231
Diamond Machine Co., Providence, R. I	Grinder, 1	450
Flather & Co. (Incorporated), Nashua, N. H	Lathe, 1	4,900
Gould & Eberhardt, Newark, N. J	Gear cutters, 4	14,750
Hamilton Machine Tool Co., Hamilton, Ohio	Lathes, 2	4,156
Hurlbut-Rogers, South Sudbury, Mass	Cutting-off machines, 4	10,624
Do	Cutting-off machine, 1	2,350
Hendey Machine Co., Torrington, Conn	Lathes, 84	191,215
Do	Lathe, 1	2,750
Do	Shapers, 2	3,700
Do	Saw, 1	900
Jones & Lamson Machine Co., Springfield, Vt	Turret lathes, 4	33,900
Landis Tool Co., Waynesboro, Pa	Grinders, 12	49,146
Do	Grinders, 3	10,950
Norton Grinding Co., Worcester, Mass	Grinder, 1	2,700
Potter & Johnston Machine Co., Pawtucket, R. I	Automatic turret lathes, 30	256,010
Do	Automatic turret lathes, 50	348,574
F. E. Reed Co., Worcester, Mass	Lathes, 8	23,117
Lucas Machine Tool Co., Cleveland, Ohio	Forcing press, 1	800
Springfield Machine Tool Co., Springfield, Ohio	Lathes, 46	112,207
Do	Shapers, 5	8,400
Do	Shapers, 2	3,168
Woodward & Rogers, Hartford, Conn	Drill, 1	775
Gisholt Machine Co., Madison, Wis	Turret lathes, 3	40,750
Do	Turret lathes, 4	42,000
Baker Bros., Toledo, Ohio	Keyseaters, 7	30,838
Do	Machine, 1	5,650
Goddard Machine Co., Holyoke, Mass	Lathe, 1	850
W. F. & J. Barnes Co., Rockford, Ill	Drills, 7	7,250
Do	Grinder, 1	1,500
A. Talla Cron (Italy)	Drill, 1	200
"Phoenix" L (Belgium)	Lathes, 11	41,748
Do	Millers, 3	3,900
Ernault & Co. (France)	Cylinder borers, 4	20,900
Do	Miller, 1	2,584
Adler	Cylinder borers, 3	15,250
Do	Cylinder borers, 6	37,053
Do	Press, 1	5,700
Alfred Herbert (Limited) (England)	Lathes, 2	6,000
Do	do	7,655
Do	Drills, 5	3,500
Do	Drill, 1	350
Do	Miller, 1	4,860
Reinecker, J. E. (Germany)	Lathes, 2	11,220
Do	Grinder, 1	7,260
Do	Tooth grinder, 1	1,800
Do	Miller, 1	5,200
Roux	Lathe, 1	1,700
Schwarzenback	Millers, 2	7,893
S. S. Jones Pollard (England)	Drill, 1	1,050

The "Fiat" works paid 259,982 lire for Lud. Loewe (German) tools. For some of these Loewe tools the prices paid were: Three lathes, 16,257 lire; 1 lathe, 5,600 lire; 24 gear cutters, 107,115 lire; 12 gear cutters, 57,520 lire; 12 drills, 32,269 lire; 4 drills, 10,760 lire; 2

shapers, 5,369 lire; 1 shaper, 2,690 lire; 7 millers, 21,302 lire. (1 lire = 19.3 cents.)

Other firms represented at the works in addition to the above are: Fillairet-Hungurt, Besse, Leipziger Werkzeugmaschinenfabrik, Naxos-Union, Deutsche-Niles, Richards, and Burton.

PURCHASES FROM AGENTS.

The agency of Alfred Schütte sold tools from the Cincinnati Milling Machine Company, Webster Machine Tool Works (Holland, Mich.), Prentice Brother Company, Bickford Drill and Machine Tool Company, Reinecker, of Chemnitz, Germany, and Landis Tool Company. The "Fiat" firm states that Schütte was paid for 8 lathes, 9,364 lire; 18 drills, 34,149 lire; 1 drill, 6,500 lire; 7 tool grinders, 7,805 lire; 17 millers, 73,872 lire; 12 millers, 61,825 lire; 2 slotting machines, 6,250 lire; 6 shapers, 15,628 lire; 1 horizontal boring machine, 4,300 lire; 2 gear cutters, 6,000 lire; 3 grinding machines, 9,800 lire; 9 grinding machines, 27,350 lire; 1 drawing bench, 3,225 lire; and 1 brake, 350 lire.

The agency of Stussi-Zweifel sold tools from W. F. & J. Barnes Company, Rockford, Ill. (eingetragene Schutzmarke: Barnes, Rockford, Ill.); Dresses Machine Tool Company, Cincinnati, Ohio, and J. E. Reinecker, Chemnitz, Germany. The prices paid to this agency for some of the tools is stated by the "Fiat" company as follows: One lathe, 1,000 lire; 14 drills, 21,605 lire; 1 grinder, 1,400 lire; 1 segatrice, 4,025 lire; 6 millers, 25,327 lire. This firm invested 42,500 lire in the German-made Meyer & Schmidt grinding machines and tool grinders. The price paid for 6 grinding machines was 30,000 lire.

THE MACHINE-TOOL WORKS OF MICHELE ANSALDI & CO., TURIN.

CONSOLIDATION OF SHOPS—PRESENCE OF MANY AMERICAN TOOLS.

The machine-tool works known as Michele Ansaldi & Co. are working at present, April 29, 830 men, and until recently was the largest machine-tool house in Italy. The plant, however, has been absorbed by Fabbrica-Italiana-Automobili-Torino, and as soon as existing orders for machine tools have been cleaned up the Ansaldi shops will work exclusively on automobile work. There are about 420 machine tools installed at this plant. The majority are the make of the firm, while the foreign contingent is divided up between American, English, and German. I observed no French tools. The majority of the foreign tools are of American construction. Among the American makes were tools from the following: Cincinnati Milling Machine Company, Cincinnati, Ohio; Brown & Sharpe Manufactur-

ing Company, Providence, R. I.; Millers Falls Company, Millers Falls, N. Y.; the Hamilton Machine Tool Company, Hamilton, Ohio; Prentice Brothers Company, Worcester, Mass.; Hendey Machine Company, Torrington, Conn.; Landis Tool Company, Waynesboro, Pa.; Pratt & Whitney, Hartford, Conn.; Lodge & Shipley Machine Tool Company, Cincinnati, Ohio. Prentice Brothers were present with drills, and the Hendey Company and Lodge & Shipley with

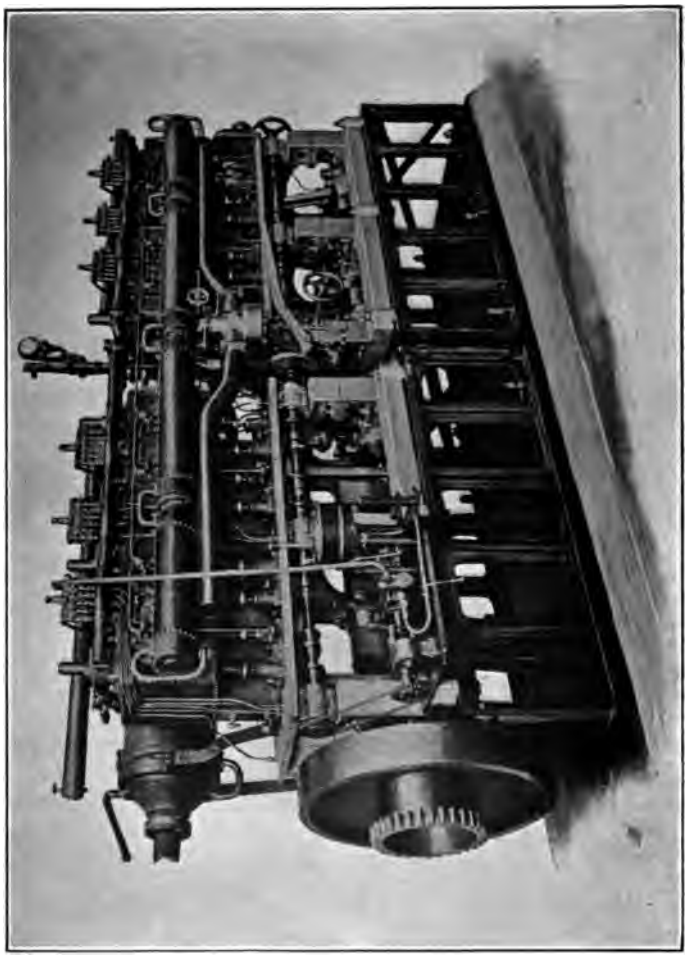

FIG. 27.—A submarine motor built by Ansaldi & Co., Turin.

lathes. There was a Pratt & Whitney miller in service, milling on large sized frames for sleeping cars. The American machine was milling the edges of the frames. I saw an Ansaldi tool doing the same job with a vertical cutter, but the Italian machine was much larger in frame than the American tool. The sleeping-car frames were first milled on the flat with the Pratt & Whitney tools, and then the edges were milled with the Ansaldi vertical miller, while the

plates lay flat. There were some large planers in service, the make of this company, the largest measuring on its table 5 meters (meter= 3.28 feet) long with a height of frame of $2\frac{3}{10}$ meters and a width of table of 2 meters.

The Anasaldi shops are turning out some motors for submarine boats, and I found one submarine motor assembled in the laboratory rooms, which will be mounted in a Swedish submarine.

MACHINE TOOLS ABANDONED.

The absorbing of the Ansaldi shops removes a very strong firm from the machine-tool building business in Italy. The field is now restricted to three machine-tool houses. I was advised at the Ansaldi shops that that firm would not undertake any further building of machine tools. The absorption was agreed to at a time when the automobile business was at its best, and the addition of the Ansaldi shops with their large installation and first-class organization practically assured to the "Fiat" company a double output capacity in automobiles. It is doubtful if any such combination could be effected at the present low stage of the automobile industry. The increased facilities will undoubtedly enable this establishment to turn out machines at much less cost than heretofore, but it will require a great many orders to keep all the shops going. The united shops represent a total working organization amounting approximately to 1,600 men.

69915—09——14

UNITED KINGDOM

MACHINE-TOOL TRADE IN UNITED KINGDOM.

THE WORKS OF JOHN LANG & SONS, JOHNSTONE, SCOTLAND.

During some months on the Continent in 1908 the writer frequently observed machine tools from the Scottish firm of John Lang & Sons installed in continental plants. In view of the high estimate held of the Lang lathes, particularly in France, a visit was made to the Lang works at Johnstone. My acknowledgments are due to Mr. James Lang for the facilities accorded me to inspect all parts of the works.

John Lang & Sons is the first plant found by the writer in Europe which is confining its attention largely to the manufacture of one line of tools, namely, lathes. In my opinion the Lang lathe is a splendid machine, and it is not surprising that it should have made good headway among the continental shops. The Lang works are located in Johnstone, a village distant by railway about thirty minutes from Glasgow. The town seems to be admirably situated for machine-tool work, and is just far enough away from the shipyard district on the Clyde to make it possible to segregate, as it were, the machine-tool workmen. Just now Lang & Sons are working about 500 men, but I understand that when the shops are running at full force the number employed approximates 700. The general situation of the trade in England has affected this plant as well as others, and everywhere I hear, at this writing (August 6), that trade conditions are very bad. I have been told that trade has never been so bad within the past ten years as now.

FOREIGN TOOLS FREELY USED.

Mr. Lang made it very clear that his firm was in the market at all times for the best tools obtainable, regardless of origin, and as an instance of this he called attention to the large proportion of American machine tools now in service in his shops. He said in effect that since his firm was a manufacturing one it was to his interest to produce at the lowest possible cost; and if an American machine tool possessed the features which would enable him to reduce expense, such a machine would appeal at once to him.

I found the following American machine tools in service at the Lang works:

Pratt & Whitney, Hartford, Conn., threaders; Gleason Works, Rochester, N.Y., gear cutters; Gould & Eberhardt, Newark, N. J., gear cutters and shapers; Brown & Sharpe Manufacturing Company, Providence, R. I., gear cutters and grinders; Landis Tool Company, Waynesboro, Pa., grinders; G. A. Gray Company, Cincinnati, planers; W. P. Powell Company, Worcester, Mass., planers; American Tool Works Company, Cincinnati, planers; Cincinnati Milling Machine Company, Cincinnati, millers. In the molding department I observed some Pridmore molders. These molders were working in conjunction with molders of English make.

The European tools in service were represented by lathes of Lang's own make and other firms, as follows:

Wanderer, of Chemnitz, gear-hobbing machines; Ludw. Loewe A. G., Berlin, cut-off and milling machines; J. E. Reinecker, Chemnitz, gear planing and milling machines; Bateman Brothers, Leeds, planers; Biernatski & Co., Chemnitz, gear-hobbing machines; "Massey," Manchester, steam hammers; Schuckert & Schutte, Berlin, gear-hobbing machine, name of manufacturer not indicated; Smith & Coventry, Manchester, slot-drilling machine; Douglas & Fraser, Arbroath, Scotland, drills.

My attention was directed to a Bateman (English) planer in service having two speeds. Mr. Lang said this machine yielded a cutting speed of 42 feet per minute and a return speed of 210 feet per minute. "It may be claimed," Mr. Lang remarked, "that these speeds are obtained in the United States, but it must be borne in mind that the speeds indicated are cutting speeds on hard cast iron, and not on the general run of softer metal as used in America." These planers are provided with cushion springs.

GEAR CUTTING AND HOBBING MACHINES.

Mr. Lang has a high opinion of the Gleason gear cutters. I think there are at least 11 of these cutters in service, and one Reinecker (German) gear cutter. It was explained that better work could be done with the Gleason machines than with the Reinecker-Bilgram. It is the experience of the Lang shop that better finished work can be secured with the Gleason than with the Reinecker-Bilgram. It was said by Mr. Lang that theoretically the Reinecker tool is well designed, but that when it comes to actual service he finds the Gleason superior.

On the subject of gear-hobbing machines, Mr. Lang declared that the hobbing machines can not do as good work as a straight out-and-out gear cutter, such as Brown & Sharpe and Gould & Eberhardt make. I saw a Wanderer hobbing machine and a Biernatski machine working close to a Gould & Eberhardt, and Mr. Lang summed up the situation by saying that for all ordinary work the two German-made *obbing* machines sufficed, but if he wanted to gear a wheel to sell

he would do the work on a Brown & Sharpe or Gould & Eberhardt. It all resolved itself, he declared, into a question of pounds and pence. He asserted that the hobbing machines can not cut straight teeth. This statement, he says, may be combated, but it is based on his experience after long service.

Speaking of grinders, Mr. Lang said that the important feature, aside from the accuracy which the American grinders possessed, is to secure as little vibration as possible, and he believes that the overhead drum is the controlling factor.

The drills in service at Lang's are made by Douglas & Fraser. I understand this firm only builds to order.

THE LANG LATHES.

Some levers on the Lang lathes are made of cast iron and some of forged mild steel; the castings are cast iron, and protection screens are furnished with the lathes to comply with British law. The tool posts are made after the usual European pattern. The bearings are made of gun metal after admiralty specifications, which call for 88 per cent of copper, 10 per cent of tin to harden, and 2 per cent of zinc for flux. The copper used must be pure copper, and this does not permit of running in any copper piping or any other form of scrap.

The keyway work on the Lang spindles was being worked up by Smith & Coventry tools, and some surprise was expressed that a type of tool for this work has not been presented from the United States. One of Lang's triple-geared lathes is used in turning up 12-inch projectiles, and the claim is made that for this particular kind of work a Lang tool will meet requirements by about 50 per cent quicker speed than any tool in use in the United Kingdom.

An important feature connected with the Lang lathes is the utilization of a patent variable speed drive, the speeds having a gradual progression in contradistinction to the speeds given by the step-cone. The surfacing and boring lathes fitted with this drive are so arranged that the revolutions of the spindle automatically increase as the diameter being turned becomes smaller. The fast headstock fitted with this variable speed drive allows a workman to get the correct surface speed for turning any diameter within the range of the lathe, however small the variation. A handwheel conveniently placed permits the workman to get the correct cutting speed without handling the belt. The same operation which changes the speed moves an index to show at all times the diameter being turned. Single or treble gear can be used and are so arranged that when running at the greatest speed there is a reduction by gearing. It is asserted that through this arrangement the lathes have greater power when turning small diameters than when belt is used driving direct to main spindle.

GEARING CONSTRUCTION AND OPERATION.

Lang makes fast headstocks of the ordinary double-gear step-cone type. These lathes have extra large cones for wide belts, the idea

FIG. 28.—Lang high-speed lathe.

being to give increased power for general work. The gearing is proportioned to give an equal percentage of variation at each change of speed, and the cone is turned inside and balanced. The fast head-

stocks when made for high-speed cutting lathes are treble geared. When turning shafting roughing cuts can be taken, it is said, at 50 to 100 feet per minute surface speed, and by moving a locking bolt in front of the fast headstock a finishing speed of from 16 to 30 feet per minute surface speed may be had without altering the position of belt on cone. Another special feature in the gearing is the arrangement for cutting coarse pitch screws or worms. The cone is on side shaft, which is geared to the main spindle at ratio of 6 to 1, or thereabouts. This cone shaft may also be geared direct to the leading screw by change wheels. Thus, when equal change wheels are on the cone shaft and leading screw, the pitch of screw being cut would be 3 inches or thereabouts, with a leading screw of ½-inch pitch. It is claimed that by this arrangement the strain on change wheels is very much less than when the screw is driven direct from the main spindle. Owing to the large diameter of the smallest step of cone there is a consequent small variation between each step.

All fast hemlock spindles are made of crucible cast steel, ground cylindrically and tested to the $\frac{1}{10000}$ part of an inch. These spindles run in parallel gun-metal bearings of extra large diameter. The bed of a Lang lathe is very wide, especially on the body, the idea being to give great rigidity for heavy cutting. The saddle has a longitudinal guide about ten times greater than its width. These proportions obviate any tendency of the saddle to twist when being moved along the bed. There is a quick hand traverse by a rack and pinion, a compound slide rest with large bearing surfaces for wear, and a swivel arrangement for conical turning, with machine-divided index.

The screw-cutting and feed motions do not permit of screw and shaft revolving at one time, and it is not possible to put the surfacing and sliding feeds into action together. The screw or shaft can be started, stopped, or reversed while the lathe is running. There are four feeds, both for sliding and surfacing, which may be changed while the lathe is running, and four screws of different pitches can be cut, any one of which may be had without stopping the lathe. These cuts may be altered by change gears, and every alteration allows of four different pitches being cut. The feeds for surfacing and sliding remain constant and are not affected by alteration of change gears. The nut for the lading screw is in half, gripping top and bottom. All the gearing, including change-wheels and rack, have teeth machine-cut from the solid.

WORKMEN AND WAGES.

The premium and bonus system is in vogue at the Lang shops, and I noticed that jigs are employed. The writer was forcibly impressed with the modern character of this plant. The whole atmosphere is

progressive, and I know no shop on this side of the water where an American tool possessed of merit would be more welcome than in these Johnstone works.

Tool men receive on an average 8½d. (17 cents) per hour. A week's work comprises fifty-four hours. The shops open at 6 in the morning and work continues until 9, resuming at 9.45 a. m. and continuing until 1 p. m., when there is a lay off until 1.45 p. m. The shops close at 5.15 p. m. On Saturdays they close at 12 m.

THE WORKS OF THOMAS SHANKS & CO., JOHNSTONE, SCOTLAND.

The firm of Thomas Shanks & Co., of Johnstone, Scotland, is one of the leading houses in Europe for the manufacture of heavy machine tools. This firm is to the United Kingdom what Niles-Bement-Pond is to the United States, and what Ernst Schiess is to Germany. My attention was especially attracted to Messrs. Shanks's heavy tools within the past two months, when visiting the leading French manufacturing plants. I found enormous Shanks tools in the St. Chamond works, and at Le Creusot and elsewhere, and that the tools of this firm are drawn upon largely by French arsenals and naval establishments. The same tools also find their way into Russian Government yards, and I understand that many of them have been sent to Germany. As pointed out in previous reports, the heavy-tool industry is practically covered by European firms, and the opportunity for American machine tools abroad is largely confined to the medium-sized and the smaller tools.

ACCURACY OF THREADING.

Shanks & Co.'s works (August 7), in common with the majority of English establishments, is rather quiet, but I understand that when running at full force about 350 men are employed. Although the firm goes in more especially for heavy tools, machines of the medium sizes are also made to special order. It can be said that they are not afraid of sizes, and I doubt if there are any larger tools made in Europe that are handled by this firm. Special pride is taken in the accuracy of the thread work on the leading screws of lathes, and I understand the accuracy of this threading is absolutely guaranteed. Practically all the engine (turbine) work for the steamship *Lusitania* was handled by Shanks tools. Mr. Shanks is a firm believer in cast-iron bearings when using Scotch metal for slow speeds, and this metal, it must be understood, is generally harder than is used in the United States. Messrs. Shanks buy all their castings, preferring to adhere strictly to machine work. Brown & Sharpe have been drawn on for *gear*-making tools, but with the exception of this firm and Tangyes,

of Birmingham, who supplied drills and Lang lathes, practically all the equipment in the Shanks shops is of the firm's own make. Messrs. Shanks plane all keyways of shafts where these keyways are of any length, but for small keyways they prefer to mill.

VARIETY OF TOOLS MANUFACTURED.

The main erecting shop is a spacious, well-lighted building of modern construction. I observed one big planer running four cutters using English tool steel, and Mr. Shanks observed that he believed in making a tool work more even at the risk of a loss of speed. The principal tools manufactured comprise:

Heavy quadruple-geared lathes, with double slide beds for marine crank axles, steel ingots and general work; heavy quadruple-geared double-bed lathes, with Barrow's patent additional details for L. P. rotors; quadruple-geared surfacing lathes, with or without loose headstocks, for cylinder covers, piston rings, cylinder liners, and general work; quadruple-geared surfacing lathes, with or without loose headstocks, with gap frame for dealing with large diameter fly wheels; quadruple-geared single-bed shafting lathes, for marine shafts, connecting rods, piston rods, and long screws; quadruple-geared double-bed shafting lathes, for heavy shafting, thrust bearings, and general work; quadruple-geared single-bed slide break lathes, with gap frame, for work of large diameter, as well as for shafts and general work; quadruple-geared double-bed slide break lathes, with gap frame, for work of large diameter; double-geared slide and screw-cutting lathes; special lathes, such as railway-wheel lathes, lathes for turning locomotive and carriage axles; apprentice lathes for sliding and surfacing general work, with and without hollow mandrel; apprentice lathes with hollow mandrel and revolver rests for bolt and rod work; steam turbine casing boring machine; universal horizontal boring machines, for drilling, tapping, studding, and boring, and for milling flat surfaces; large universal horizontal boring machines; furnace-front boring, tube-plate boring, Corliss-valve boring, and long-shaft boring machines; special drilling and boring machines, such as boiler-shell drills, boiler-back drills, duplex marine shaft-coupling drills; radial drilling machines, rectangular box radial drilling machines, wall radial drilling machines; vertical boring machines for built-up cranks, and vertical drilling machines; cylinder-boring machines, boring bars; slotting and planing machines; vertical and horizontal planing machines, large size; vertical and horizontal planing machines, and large screw slotting machines; planing machines, heavy, for armor plates; planing machines for general work; plate-edge planing machines; general and special shaping machines; horizontal plate bending rolls, for shipbuilding and boiler work; patent vertical plate bending rolls, for marine, locomotive, and stationary boilers; punching and shearing machines; power traveling cranes; jib traversing cranes.

RESULTS FROM MOTOR DRIVING.

The opinion is held by Messrs. Shanks that motor driving on machine tools neither adds to nor detracts from the tool. On the other hand, it is contended that by increasing the width, thickness, and strap velocity of belt, and providing the mechanical means of tightening it to the right tension until it is competent to deal with the

heaviest cuts at the highest speeds, that the perfection of driving is arrived at. The countershaft and pulley, it is further asserted, should be self-contained with the machine. It is contended that by belt driving there is more safety against accidents which would smash expensive details where the potential power of a direct driving motor is used. The firm, however, declares that it is not averse to direct driving, especially for heavy lathes, but it is evident that Messrs. Shanks prefer belt driving.

On the subject of high-speed cutting, it is maintained that if much material has to be removed the method of slow cutting and heavy feeds are far ahead in producing quickly accurate work. The experience of Messrs. Shanks is directly against the running of tables for heavy planing machines at high speeds of cut and reverse, or by cutting both ways, as a means of escaping the difficulties of a quick return.

GEARING HEAVY TOOLS.

With reference to the gearing of heavy tools, this firm maintains that the ordinary machine-cut gearing, although adopted by them, is all very well for a few months, but it does not stand the test of years. It is pointed out that the wear on the driving tooth is from the pitch line to point, and on the driven from pitch line to root, and that in consequence the driving wheel (apart from this wear) has only half the strength of the driven wheel. The Shanks works have abandoned the use of involute teeth, except for change-wheels and intermediate gearing, because of what is termed the intense outward strain upon the bearings and frictional and wear of the rotating surface. Only epicycloidal teeth, special and different shapes of teeth for driver and driven, are used, and the preferential use of steel for driver, and specially hard cast iron for the driven, and where there is high-gear velocity recourse to gun metal. All gearing, whether bevel or spur or worm, is machine cut. All important bearings are provided with gun-metal bushes and caps for adjustment of wear, and all bearings that are liable to seize from carelessness in oiling are bushed with gun metal. All loose pulleys are made to run on an oiling bush.

LATHES AND BORING MACHINES.

Messrs. Shanks are building a turbine quadruple-geared double-bed lathe of seven different sizes. The largest size has a height at centers measuring 81 inches, with width of double-slide bed measuring 12 feet 4 inches; length of bed, 57½ feet; and distance between centers, 40 feet. In Class G boring machines for steam turbine casings they make one tool having a width of slide bed measuring 7 feet 6 inches; traverse of column measuring 9 feet 6 inches and a diameter of 17 feet capacity for the largest diameter of the bore. The diameter of

the worm wheel is 84 inches, the length of the work plate is 53 feet, and the width 18 feet.

Of the large universal horizontal boring machines there is one tool made which has a diameter of spindle 7½ inches; ratio of torsion, 421; feed traverse of spindle, 60 inches; horizontal range of spindle, about 16 feet; vertical range of spindle, about 10 feet; width of slide bed, exclusive of projections, 6 feet 4 inches.

There is one very heavy special boring machine for boring holes up to 15 inches diameter through long shafts up to 34 inches diameter and 70 feet long. The machine includes a strong middle foundation plate with two beds, each 41 feet long and 4 feet 6 inches wide, checked and bolted thereto, and 93 feet over all.

Radial drilling machines range in various sizes, the largest having a diameter of spindle of 5 inches; feed traverse of spindle, 36 inches; maximum radius of spindle, 13 feet; minimum radius of spindle, 3 feet 7 inches; greatest height of spindle from base plate, 13 feet; vertical adjustment of arm, 5 feet.

The armor-plate planing machines are of various sizes, the maximum having the following dimensions to plane in, viz: Width, 16 feet; height, 12 feet; length, 24 feet. The length of bed at front is 22 feet 6 inches; at back, 19 feet 6 inches; and the total length is 42 feet.

Reference was made in a special report on the St. Chamond Works, France, to the Shanks gun lathes in service there. The tools furnished to St. Chamond by Shanks & Co. were said to be among the heaviest in use in the St. Etienne district in France.

THE WORKS OF G. & J. WEIR, CATHCART, NEAR GLASGOW.

HIGH-GRADE TOOLS USED IN PUMP MAKING.

The firm of G. & J. Weir (Limited), of Cathcart, is one of the widest known makers of pumps in Europe. Many marine engineers of America know the Weir pump, and the reputation of this auxiliary in steam installation aboard ship is an enviable one. Weir pumps have found their way into locomotive service, as recent experiments on the Egyptian State railways show, which service was referred to in a previous report. In view of the fact that the outputs of the Cathcart firm are of the very highest order, it was only natural to assume that high-grade machine tools could be found in service at this plant. I visited the Weir works on August 7 and every facility was accorded to inspect the shops.

It is an interesting fact that four Weir air pumps are going into the new U. S. battle ship *North Dakota*, and at the time of my visit I was advised that a member of the firm would shortly leave for the United States in connection with further negotiation looking to

the manufacture there of Weir pumps. The British armored cruiser *Indomitable*, which recently completed a run from the mouth of the St. Lawrence to Cowes, England, at an average speed of over 25 knots per hour, is equipped with 52 Weir pumps. This same type of pump is in service on board the steamships *Lusitania* and *Mauretania*, and I understand are used exclusively in the British navy.

The Weir works are employing at present about 1,300 men, but when running full the number is 1,800.

AMERICAN AND OTHER FOREIGN TOOLS USED.

I found the following makes of American machine tools in service on the Weir floors:

Brown & Sharpe Manufacturing Company, Providence, R. I., grinders and millers; Norton Grinding Company, Worcester, Mass., grinders; Jones & Lamson Machine Company, Springfield, Vt., turret lathes; Gould & Eberhardt, Newark, N. J., shapers; Davis & Egan, Cincinnati, drills; American Tool Works Company, Cincinnati, drills; Bickford Drill and Tool Company, Cincinnati, drills; Acme, Cleveland, screw machines; C. C. Bradley & Son, Syracuse, N. Y., hammers; Potter & Johnston, Pawtucket, R. I., automatic turret chucking and turning machines; in the molding departments several Predmore molds.

The foreign makers were represented by the following:

G. & A. Harvey, Glasgow, horizontal borers; Ludwig Loewe A. G., Berlin, shapers; Deutsche-Niles, Berlin, boring mill; J. E. Reinecker, Chemnitz, millers; Alfred Herbert, Coventry, England, turret lathes; John Lang & Sons, Johnstone, Scotland, lathes.

AIR PUMPS AS EFFICIENT AGENTS.

The air pumps manufactured by the Weir firm are of the independent type. These, as engineers well know, tend to relieve the main engine of duties other than that of propelling the ship. In stationary power plants the independent air pump has been in service for many years, but the conditions on board ship have for a long time prevented the use of the stationary land type. The tendency, however, to employ separate engines for all auxiliary duties is yearly becoming more marked. The advent of the independent air pump has been the outcome of the difficulties accruing from the use of the attached air pump. It is well known that the greater the difference between the initial pressure in an engine and the exhaust pressure the greater the amount of power which can be utilized in the engine, and hence there is a demand to secure this difference by means of a high vacuum.

The minimum expenditure in an engine is the amount of heat needed to raise the water at the exhaust temperature to steam at the boiler pressure, but the lower the exhaust pressure the lower also the temperature of the feed water issuing from the condenser. From

this, as Messrs. Weir assert, arises the necessity for a practical compromise to secure the most economical working of the engine. Added to this, they say, is the further consideration that in reciprocating engines the practicable areas of the valves and cylinder ports render inadmissible the full utilization of as perfect a vacuum as can be secured. In the steam turbine, they point out, no such restrictions of port area exist as in the reciprocating engine, and provision for the increased volume of the steam is simply and practically made; hence advantage can be taken of as high a vacuum as is obtainable with a corresponding increase in the efficiency of the turbine engine. The function of condensers, it is well understood, is to condense the exhaust steam to water, and if the condenser be an efficient one the water will be at the temperature of the exhaust steam.

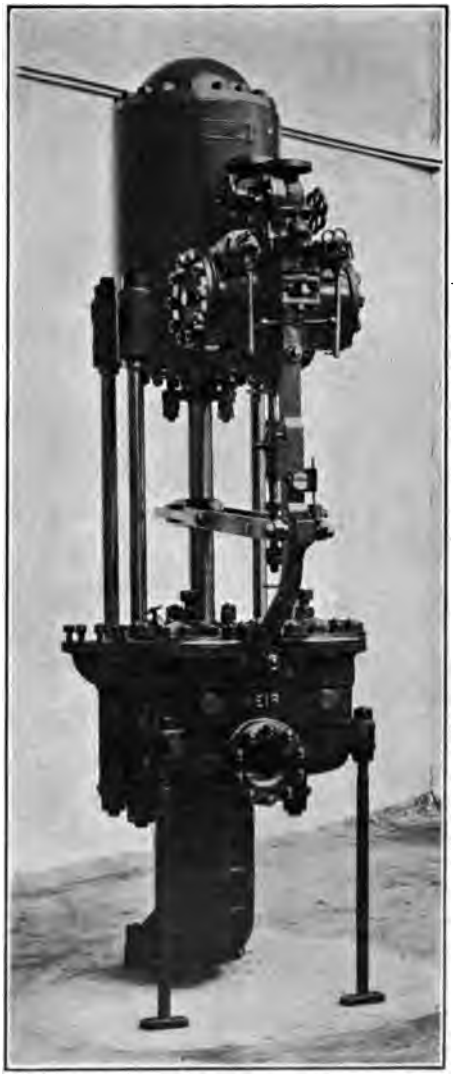

FIG. 29.—Weir feed-pump—admiralty high-pressure type.

SINGLE AND DOUBLE ACTING PUMPS.

Messrs. Weir declare that for the independent air pump the vertical single-acting type is better than the horizontal double acting. The advantage, they declare, is in the certainty of action in forcing the water through the bucket valves, the natural method of collecting the water in the bottom of the pump ready for the bucket, the uniform efficiency of the whole area of the valve opening, the flow being always in one direction, and the simplicity of water-sealing valve. Messrs. Weir declare that independent air pumps must be direct act-

ing and driven by direct-acting steam cylinders. To achieve this, they say, it is necessary to have a form of steam valve which will be reliable under varying conditions of air-pump duty, and which will give steam to the cylinders in the correct ratio to the work done.

FIG. 30.—Weir monotype air pump—admiralty type.

VARIOUS TYPES.

For main air pumps the Weir shops manufacture a foot bucket and head-valve arrangement. The suction valveless type has been discarded for this kind of work except for special purposes, claiming that an advantage lies with what is called the triple-valve arrangement. The especial valve of the independent air pump is said to be emphasized in connection with turbine work, and for efficient turbine service a high vacuum is indispensible to securing the utmost efficiency.

The Weir shops are turning out a twin type air pump which they recommend for installations having over 6,000 indicated horse-power in single units, and where weight and space are not absolutely the first consideration. Other types manufactured are known as the "monotype," the "single dry air pump," and the "twin dry air pump." Weir manufactures what is termed a "biflux" condensing plant and a combined air and circulating pump. Weir is also manufacturing feed regulators for water-tube boilers, high-pressure feed pumps, differential pumps, and, more *recently*, special types of pumps for oil fuel.

OIL PUMPS INSTALLED.

Last year Messrs. Weir completed a very important pumping installation for the Burmah Oil Company, comprising 12 triple-expansion direct-acting pumping engines, arranged in two stations of 6 engines each, each station capable of discharging 25,000,000 gallons of oil per month a distance of nearly 300 miles. It is interesting to note that this appears to be the first oil-pipe line equipped with machinery not made in the United States.

The Weir shops are working on a premium basis, and the average rate of wage for a tool man is 8½ pence (17 cents) per hour. One part of the plant is made up of union men, while another part consists of nonunion men. The two factions are kept separate.

THE WORKS OF ALFRED HERBERT (LIMITED), COVENTRY, ENGLAND.

HERBERT TURRET LATHES—AMERICAN TOOLS IN USE.

In reports from the Continent of Europe reference was repeatedly made to the turret lathes built by the English firm of Alfred Herbert. I think it is safe to say that I found more Herbert machine tools on the Continent than from any other single English firm. There is no denying that the Herbert machine tools, and in particular the turret lathe of this firm, are strong competitors of the best work turned out from American shops. From several months' observation in Europe I am convinced not only of the excellence of Herbert material but the efficiency of the commercial branch of this firm. It is notworthy that Herbert is selling his own goods, and so far as I know his agents are under his direct control.

The Herbert works are located in Coventry, and upon the occasion of my visit every opportunity was accorded to inspect the works. This is one of the most up-to-date plants for the manufacture of machine tools which has come under my observation since leaving America. The methods in vogue are essentially American, and it is interesting to know that the technical control of the plant is in the hands of Mr. Oscar Harmer, an American. Under such circumstances it is not surprising that the very best features to be found in American plants are observable in the Herbert works, and the clear-sightedness of Messrs. Herbert is further attested by their readiness to avail of most modern methods.

COMPETITION WITH AMERICAN MACHINE TOOLS.

The Herbert tool which probably competes the strongest with American products is the hexagon turret lathe. There is no denying that this is a beautiful tool, solid in construction, and evidently in-

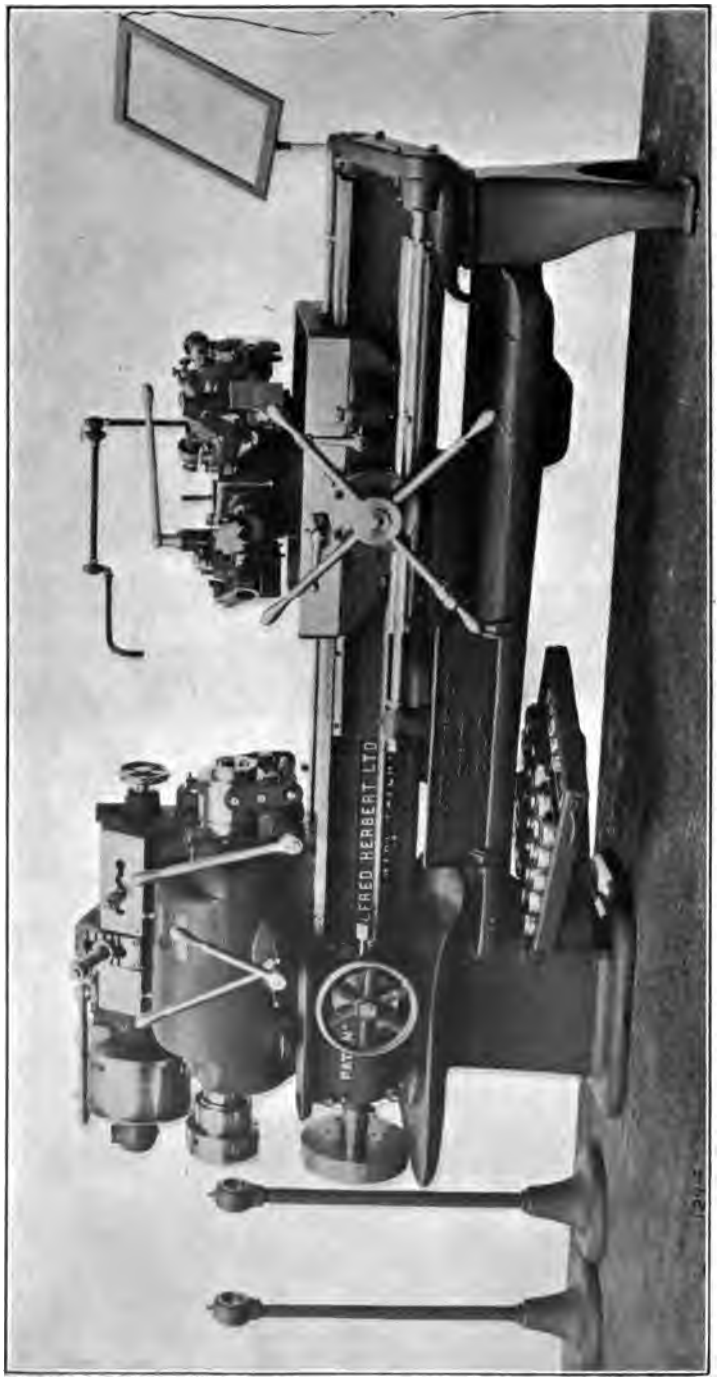

FIG. 31.—Alfred Herbert (Limited), No. 2 hexagon turret lathe.

tended to last for many years. It would seem as if the best American features coupled with a British sense of stability and long life have been united in this design and that it has been built evidently with a direct view of meeting European requirements.

VARIETY OF MACHINE TOOLS TURNED OUT.

The Coventry firm has not yet been able to confine itself to the manufacture of one machine. For this reason the tools manufactured here comprise turret lathes, milling machines, milling cutters, cutter-grinding machines, valve-grinding machines, drills, drill grinders, capstan lathes, shaving lathes, stud-making lathes, chucks, capstan tools, taps and dies, combination turret lathes, chucking machines, boring heads, single-spindle centering machines, hexagon turret lathes, automatic screw machines, automatic stud machines, automatic copper-stay machines, automatic turning machines, and universal tool-grinding machines.

Messrs. Herbert handle the Darling & Sellers (English) engine lathe. They also sell a number of American tools, and in so doing act for the American manufacturer in the capacity of agents or merchants. The best of American machine tools sold by Messrs. Herbert include:

The broaching machines of the Lapointe Machine Tool Company, Hudson, Mass.; metal sawing and saw-sharpening machines as manufactured by the Cochrane-Bly Company, Rochester, N. Y.; lathes, standard and radial drills, and crank shapers as manufactured by the American Tool Works Company, of Cincinnati, Ohio; crank shapers of the Springfield Machine Tool Company, Springfield, Ohio; universal milling machines of the Owen Machine Tool Company, Springfield, Ohio, and gear cutters of the E. J. Flather Manufacturing Company, Nashua, N. H. Messrs. Herbert make milling machines of the plain, universal, and vertical types. The vertical drills are of the forms peculiar to American designs, but in addition a line of small drills is turned out which compete with the outputs of firms like Dwight Slate & Co., of Hartford, Conn.

METHOD OF GEARING—MILLING MACHINES.

In the Herbert horizontal milling machines the cone pulley and gearing give all speeds in geometrical progression, and it is claimed that this method was first introduced by Herbert. All machines are geared and all gears are covered, not a single gear being in sight anywhere on the machine. The table is unusually thick to prevent distortion by the clamping of the work. There is a covered way from one end of the table to the other to prevent flooding by cuttings blocking up the channels, and it is claimed that this is a feature not possessed by other machines. The whole machine is operated from the front without the attendant changing his position or going around to the back. The gearing is completely inclosed and three spindle speeds are provided. There is a patent dial feed motion which makes this tool very efficient.

Herbert makes a specialty of heavy milling work, and machines designed for this service have a most efficient clutch drive and a rigid support for the outer end of the cutter arbor. Gang milling also forms a specialty. The line of vertical millers manufactured are designed for recessing, circular milling, slot milling, scroll and cam milling, and it must be said that the line of tools for this work is an exceptionally fine one. In this connection it should be mentioned that the milling cutters form a specialty of the Herbert outputs. The steel is of English origin.

DRILLS AND CAPSTAN LATHES.

Ball bearings are used in the vertical drills. Messrs. Herbert utilize chucks made by the Jacobs Manufacturing Company, Hartford, Conn.

The Herbert capstan lathes are of a modern and rigid design. The lathes are made in three distinctive types, namely:

(1) With plain cut-off rests for repetition work of a simple nature.

(2) With traversing saddles for varied work and for face-plate and chuck work..

(3) With chasing saddles for general repetition work requiring the cutting of external or internal threads of larger diameter than can be dealt with by dies or taps; also for square threads and threads of accurate pitch. The heads are of all four types—ungeared, duplex, friction geared, and "single pulley."

Automatic chucks with positive bar feed are fitted to a number of sizes of these lathes. On all Herbert capstan lathes above the No. 2 sizes the turrets or capstans are hexagonal in form. The larger sizes have clapping handles for binding the capstan to the slide for heavy cutting. The tools are held by binding pads designed to not bruise the shanks. The tool holes are in line with the spindles, and the faces of the hexagonal capstan are scraped true with the spindles. These capstans have from two to six adjustable stops, which swing out of the way when not in use, and all the capstans revolve automatically. I noticed that Herbert uses the Anferican type of tool posts on his capstan lathes.

The turret lathes have been specially designed for dealing with work such as cylinder covers, piston bodies, heavy glands, motor-car cylinders, valve bodies, piston rings, gear blanks, pulleys, couplings, breech screws for guns, projectiles, and the various details of high-speed engines, dynamos, motors, gas engines, machine tools, and ordnance. They can also be employed upon certain classes of bar work, such as heavy bolts and large valve spindles in which square threads are required. The headstock is very powerful. It is provided with duplex back gear and quadruple clutches, which are operated by means of the two levers at the front of the headstock. This arrange-

ment enables six speeds in the case of Nos. 15 and 16 lathes and nine speeds with the No. 17 lathe to be instantly obtained at any time without shifting the belt upon the cone pulley. By changing the belt upon the cone pulley a total range of 18 speeds is available.

FACILITY IN CHANGING SPEED.

The speeds can be changed on these lathes with great facility. The whole of the headstock gearing is entirely covered. The spindle is of hard steel, the flange for carrying the chuck is forged solid upon it, and the bearing caps are tenoned into the headstock both longitudinally and transversely. The main turret is hexagonal. The automatic feed to the main turret has 18 changes, including the fine speeds required for heavy drilling on steel forgings and coarse feeds for turning and for boring castings having bored holes. The change from the coarse to the fine range of feeds is made by a small lever in front of the turret slide. Six independent adjustable stops are provided, which trip the feed motion at any desired point and which are self-selecting, i. e., the stop relating to the particular tool in operation is always in gear, the other stops being out of action at the time. The stops also act as dead when feeding the turret by hand. The automatic feed is reversible. The square turret is mounted upon a saddle having automatic longitudinal and cross feeds, both reversible. It is made from a solid steel forging and carries four turning tools or such special tools as may be required by the nature of the work. The automatic feeds have nine changes.

Herbert is cutting his gears for the turret lathes on hobbing machines. In a previous report I mentioned the reluctance of one English machine-tool house to use hobbing machines, on the ground that it was impossible to cut teeth straight. Messrs. Herbert, however, do not appear adverse to employing these machines in building up their automatic turret lathes, and this fact is noteworthy in view of the great care exercised at Herbert's in the construction of tools.

As an instance of rapid tool work, the Herbert hexagonal turret lathe is able, I am advised, to reduce a bar from 2 inches diameter to three-fourths inch diameter at the rate of 10¼ inches per minute. Jigs are freely used, and a practice is made also of storing bed castings for a period of about six months. Before storing the castings are planed. During the storing period the castings, it is observed, change in form considerably, going first one way and then another, and frequently it is necessary to take a light-finish planing cut over them after they have been seasoned.

When running under full power the Herbert shops employ about 1,500 men, but owing to the slackness of trade about 1,000 men were working at the time of my visit, August 10. On an average good tool men receive on piecework about 1 shilling (24 cents) per hour, a week's work comprising fifty-three hours.

THE HANS RENOLD CHAIN-MAKING WORKS, AT MANCHESTER.

The chain-making works of Hans Renold (Limited) are located on the outskirts of Manchester. I visited this plant on August 11. The guiding spirit of this well-known establishment is Mr. Hans Renold, a Swiss by birth and education, who derived his engineering instruction from the University of Zurich. Some thirty years ago, assisted only by one man and a boy, he commenced the manufacture of chain in Manchester for use in textile machines. From this small beginning in a single rented room the business grew, until to-day the Renold works comprise a floor space of more than 7 acres in extent and furnish employment for about 700 people.

In visiting the plant I was actuated both by a desire to meet and talk with a man of the experience of Hans Renold and to note the character of the machine tools in service. The reputation of this firm is for work of a high degree of merit, and it was reasonable to assume that only the most accurate and efficient tools would be found, which assumption was fully borne out by observation. The number of Brown & Sharpe tools in use suggested a shop equipped with tools of that American firm. Other fine American-made tools were in evidence, but in point of numbers the equipment was mainly from Providence, R. I. In addition to Brown & Sharpe machines, I observed tools from the F. E. Reed Company, Worcester, Mass.; National Machine Tool Company, Tiffin, Ohio; Hurlbut-Rogers Machine Company, South Sudbury, Mass.; Flather & Co., Nashua, N. H.; Bullard Machine Tool Company, Bridgeport, Conn.; Detrick & Harvey, Baltimore, Md., and M. F. Manufacturing Company, Millers Falls, N. Y.

The foreign makers were represented by Alfred Herbert (Limited), Coventry; John Lang & Sons, Johnstone; Muir & Co., Manchester; J. E. Reinecker, Chemnitz, and Richards & Co., Broadheath, near Manchester.

I observed a 10-inch Hurlbut-Rogers cutting-off machine in use. Mr. Renold informed me that he would like to have secured a machine of this type for 14-inch work, but so far as he knew Hurlbut-Rogers made no machine larger than the 10-inch size. Mr. Renold spoke highly of a new Bullard boring mill and declared that he could do about 30 per cent more work with this new tool than with one of the old types. Mr. Renold is inclined to think that in the present state of development of hobbing machines better results can be obtained with single milling cutters.

CHAIN-BELT MAKING.

The chain-making work at the Renold plant calls for much automatic service, and speaking roughly I should say that there are at least 200 automatic machines of a medium size in service here. This

refers more especially to the machines furnished by Brown & Sharpe and Alfred Herbert.

Messrs. Renold, after branching out from work in connection with textile machinery, took up the business of supplying chain for cycles, and latterly this firm is making a specialty of manufacturing chains for driving machine tools. It is the opinion of Messrs. Renold that a chain can economically replace ropes and belts, and in the new Renold plant chain driving is employed to an astonishing extent. Three types of chain are made, namely, block chain, roller chain, and silent chain. The block chain may be run at speeds up to 500 feet per minute, and in larger sizes is used more especially for conveyor and elevator works. In the smaller sizes it is applied to feed drives on machine tools and the like. Roller chain has the rivet surrounded by a steel bush on which is a roller which actuates the sprocket teeth. Roller chains may be run up to 900 feet per minute and are made from one-half inch pitch upward, in many hundreds of sizes. They are used in cycles and motor vehicles, and also for machine driving. The silent chain is designed for high speed, and drives even when worn out, it is said, with the swiftness of a belt. In a modern form of this chain segmental hardened bushes are fixed in the hole of each row of links and bear on hardened pins, the hole in the alternate links being recessed on one side to clear them. The silent chains are capable of running up to 1,250 feet per minute and even faster, it is said, when special oiling provision is made. It is claimed that 500 horsepower can be transmitted with silent chain, and larger sizes, I understand, are now being developed. The manufacturing operations in connection with these chains is carried out with minute exactitude.

INCREASED OUTPUT FROM CHAIN BELT.

The new works of Messrs. Renold are driven only by electric power and all the motors in the shop are similar and interchangeable. They claim that by means of chain belt the output is increased by over 20 per cent, and using Brown & Sharpe tools during a trial lasting 138 hours a chain-driven machine yielded 3,074 rollers as against 2,485 rollers obtained from a belt-driven machine. It is also claimed that the work obtained from the chain-driven machine was considerably better. It is hard to account for the difference of the quality of the work, but Messrs. Renold say the belt, when hard driven, slips more or less irregularly on the smooth surface of the cone, accompanied by an alternate elongation and contraction, causing a pulsating turning. It is also claimed that only 25 per cent of drills are necessary with the chain-driven machine, and that one operator can easily attend 6 chain machines as against 2 belt driven. Only 25 per cent of the number of grinding machines was required for keeping the tools sharp, and the

wear and tear on spindle and countershaft bearings was, it is said, considerably reduced. Messrs. Renold say that during this test it was found on the chain-driven machine that by giving the 1-inch bar a circumferential speed of 75 feet per minute they obtained the best results in drilling and parting, these being the two chief operations of the belt-driven machine. No satisfactory work, it is said, could be secured with a circumferential speed of 75 feet per minute, whatever tension was put on the belt. In addition to the foregoing the broad claim is made that larger and heavier work than is possible on belt machines can be done satisfactorily on chain-driven machines. Messrs. Renold explained that in their catalogue they clearly state that while the spindle has 1-inch bore it is only meant for brass of this size, and if used for steel only ⅞-inch bar should be used. It will be observed, therefore, that the Brown & Sharpe tools were worked under excessive conditions. Evidently Messrs. Renold appreciated the capacity of these tools, and it is interesting to note that in the automatic turning department there are no less than 163 Brown & Sharpe small, medium, and large size machines in service.

In addition to the 200 automatic machines of American and English make on the Hans Renold floor, there are over 200 automatic and semitautomatic machines of special types, which are of Hans Renold design and construction. This latter machine serves as special in the manufacture of driving chains.

ATTRACTIVE AND SANITARY SHOPS.

There are few machine-tool works in Europe which present so pleasant an aspect to the visitor as the new Hans Renold works. The location of the recently erected building is in the suburbs of Manchester, with open fields, pleasant driveways, and shady trees marking the approach. The main building is artistically designed and lacks those somber features which generally characterize a manufacturing building. The interior of the main shop is well lighted, and great care and attention has been bestowed upon the sanitary arrangements. I should say that it is impossible for water to collect, and there appears to be an excellent drainway from all directions. For the most part the floor is of timber, while the building itself is of steel, brick, and concrete construction. There are a large number of women and girls employed in this plant, their work being mainly in connection with stamping machines and work of a special nature.

Messrs. Renold have aimed to make the workshop attractive for their employees, and have gone to greater length than I have so far witnessed in the United Kingdom. English shops are subject to inspection, but the requirements for the protection of workers at tools does not seem to be so rigid in the United Kingdom as in Germany.

THE WORKS OF KENDALL & GENT (LIMITED), MANCHESTER.

The machine-tool works of Kendall & Gent (Limited) are located in Belle Vue, Manchester. On the Continent I frequently found tools of this firm installed among the best of the foreign works, and so far as I could learn they were in nearly every case giving satisfaction. When running full Kendall & Gent employ about 400 men, but at the time of my visit, on August 12, the number employed was somewhat less, due to then existing quiet conditions in the trade.

The tools manufactured by Kendall & Gent comprise screwing, tapping, cutting-off, nut-tapping, radial-drilling, tapping, and studding machines, portable radial-drilling, horizontal-drilling, multiple-drilling, locomotive tube-plate drilling, traverse-drilling and double-headed slot-drilling, punch and shearing machines, special machines for boiler making, cylinder boring, facing, and slotting machines, planers, lathes, and milling machines of all classes, including (*a*) vertical milling and profiling, (*b*) milling and profiling, plano type such as are used by locomotive engineers for connecting rods, (*c*) universal and horizontal milling machines, plano type.

It will be seen from the foregoing list that a great number of tools are manufactured, but, speaking in general terms, it is the writer's observation that the drills of this firm find the most favor on the Continent, for I ran across more of their radial drills and boring tools than any other of their line of outputs. The wall radial drill of this firm I find in much favor, and the boring tools are drawn upon for a varied line of work.

RADIAL DRILLS.

The Kendall & Gent double radial drill is a tool of merit. Take, for instance, the two-spindle type of this machine, where one spindle is used for drilling with high-speed drills and the other for tapping and studding. This machine appears capable of doing the lightest or the heaviest tapping with equal ease. The operations of drilling and tapping a number of holes in succession are carried on continuously without either stopping the machine or altering the speed. When the hole has been drilled the tapping spindle, by a single movement of a handwheel, is brought exactly over the center of the hole. The tap or stud stops automatically when it reaches the bottom of the hole or if the hole be too small, rendering it impossible to break the tap. The tapping spindle is provided with a reversing motion for quickly withdrawing the tap at about three times the tapping speed and without changing the speed of any gears. The tapping spindle is of one diameter throughout. The driving is powerful, the gear box being fitted with a 3-speed cone pulley for wide belt and two ratios of steel gearing, pulley inclosed, running in an oil bath, which

with the two ratios on the saddle give twelve graduated speeds. This means four speeds, graduated on each cone speed, and any of these speeds can be changed by lever while the machine is running. The gears in the gear box, as well as those on the saddle, are of steel. All clutches are of steel, hardened, and the wheels running loose on the spindle are bushed with gun metal.

GOOD SHOPWORK.

The visitor is impressed with the fact that they do honest work at these shops. I have seen more rapid shopwork, and I have seen slower work, but there is no denying that this shop goes in for solid, substantial tools. Naturally work can not be very fast where there is not a steady flow of material through the shop, such as one is accustomed to see in works where only one type of tool is manufactured. With the exception of very few firms, the British machine-tool builder is generally a manufacturer of a varied line of machines, and when one considers the speed question in England it must be viewed generally from the standpoint of a shop which is not specializing. This explanation is necessary to understand the difference between machine-tool manufacturers in America and abroad. The American manufacturers enjoy undisputed control in a territory so great that in ordinary times the facilities are hardly equal to the demand. In this great territory there is sufficient business to warrant specializing, and with specializing comes knowledge and experience, and ability to produce at minimum cost. The value of the protective tariff to American machine-tool builders appears to be well appreciated among machine-tool men in the United Kingdom, and it is my observation that among British machine-tool makers there is a strong desire for like protection in Great Britain.

FEW AMERICAN TOOLS USED.

Kendall & Gent mill practically all teeth on shafting work, and I understand they consider milling to cost only about one-sixth that done by lathe. The only American machine tools I observed here were Brown & Sharpe grinders and Landis grinders. Biernatzki hobbing machines were in use, but Kendall & Gent supply their own cutters for this tool, claiming to be able to secure more accurate results. In a report on the Lang works reference was made to certain criticisms on hobbing machines, the principal one being that it is difficult to cut a tooth straight. I was given to understand that Kendall & Gent claim to overcome some of this difficulty through their special form of cutter; that they manufacture these cutters for the trade and recommend them for hobbing machines. All threads are milled on their spindles, and practically all work is bushed with gun metal.

The drive is electric. The voltage of the installation is 230, and the distribution of the power throughout the works is mainly by motors at 20 horsepower driving groups of machines, each group being driven from a main shaft with a motor in the center, which enables different types of machines to be driven in sections. On the main pillars in the center of the works provision is made for taking off 20 horsepower to permit of the use of motors for portable machines. The main building comprises an erecting and fitting shop measuring about 300 feet in length by 150 feet wide.

THE WORKS OF THE CHURCHILL MACHINE TOOL COMPANY (LIMITED), MANCHESTER.

COMPETITION WITH AMERICAN TOOLS.

The Churchill Machine Tool Company (Limited), of Manchester, is usually identified with Messrs. Charles Churchill & Co., of London, who are best known as agents in the United Kingdom for American machine tools. Strictly speaking, Charles Churchill & Co. are distinct from the Churchill Machine Tool Company (Limited). Both firms are represented as separate limited-liability companies. The same gentleman, however, is manager of the Machine Tool Company and the Manchester branch of Charles Churchill & Co., and the same board of directors control the two companies. The machines and tools manufactured by the Machine Tool Company are sold through the Trading Company.

The head of Charles Churchill & Co. is Mr. Charles Churchill, who is an American of long residence in England, and it may be said this gentleman was among the very first to introduce American machine tools and equipments into the United Kingdom. Mr. Churchill came to England in the early sixties, and one of the most interesting documents which the writer has seen in the course of his inspection is a bound series of catalogues which Messrs. Churchill have issued commencing with the latter part of the decade ended with 1870. This catalogue deals with American machine tools and sundry other American goods. In the machine-tool line it is tantamount to a history of American tool development.

The Churchill Machine Tool Company (Limited) works is a small plant, employing at the time of my visit on August 12 less than 100 men, but the works are capable of development, and in all probability will do good business when the present trade situation changes. Among the tools being built I observed a 28-inch drill designed for high-speed work. This tool, I was informed, has a speed capacity of 14 inches per minute, using a 1-inch high-speed drill in English cast iron. The tool is designed to use carbon-steel drills if desired, but is expected to meet the ordinary requirements of the shop. It is

evident that great care is manifested in the manufacture of this tool, which sells for £130 ($632.65).

The general dimensions of the 26-inch drill of the Churchill Machine Tool Company (Limited) are:

Center of spindle to column, 13½ inches.
Maximum distance spindle to base, 48½ inches.
Minimum distance spindle to base, 15 inches.
Maximum distance spindle to table, 35 inches.
Diameter of table, 23 inches.
Traverse of sliding head, 22 inches.
Traverse of spindle, 11½ inches.
Morse taper in spindle, No. 4.
Number of spindle speeds, 8.
Range of speeds, 13 to 300 revolutions.
Ratio of bevel gears, 2¼ to 1.
Ratio of back gears, 6 to 1.
Steps of cone, 6, 8, 10, and 12 inches.
Width of belt, 3 inches.
Number of feed changes, 4.
Range of feeds, 0.006 to 0.024 inch.
Size of fast and loose pulleys, 12 by 3½ inches.
Speed of fast and loose pulleys, per minute, 360 revolutions.
Height to top of cone, 7 feet 5 inches.
Floor space required, 5 feet 6 inches by 2 feet 2 inches.
Weight, about, 2,240 pounds.

The general dimensions of the 28-inch Churchill drill are:

Center of spindle to column, 14 inches.
Maximum distance of spindle to base, 4 feet 3 inches.
Minimum distance of spindle to base, 1 foot 11 inches.
Maximum distance of spindle to table, 2 feet 3 inches.
Size of table, 26 by 17 inches.
Traverse of sliding head, 14 inches.
Traverse of spindle, 14 inches.
Hole in spindle, No. 4 Morse.
Number of spindle speeds, 8.
Range of speeds (geometric progression), 34 to 333.
Steps of cone, 8½, 10¾, 12¼, and 14 inches.
Width of belt, 3 inches.
Number of feed changes, 6.
Range of feeds, 0.006 to 0.038 inch.
Size of fast and loose pulleys, 14 by 3 inches.
Speed of fast and loose pulleys, revolutions per minute, 303.
Height to top of cone, 8 feet 5 inches.
Floor space required, 4 by 7 feet.
Weight, about 3,540 pounds.

DRILLS AND GRINDING MACHINES.

The 26-inch drill manufactured by Messrs. Churchill is designed to compete with the tools of the Cincinnati Machine Tool Company. It has geared feeds throughout and is fitted with an oil-tray base. This

machine is not as carefully made as the 28-inch tool. There is considerable metal put into the tool, and a claim is made that it is as strong as some of the American 28-inch drills. The cost of the 26-inch Churchill drill, delivered anywhere in England, is £55 ($267.66).

Messrs. Churchill are making both universal and plain grinding machines. The universal grinder is being made in two sizes and the plain in four sizes. This concern is probably doing as good grinding

FIG. 32. The 28-inch drill, Churchill Machine Tool Company (Limited).

work as is to be found in the United Kingdom, and I noticed they are putting considerable metal into these machines.

The principal dimensions of the 10 by 50 inch plain grinding machine are:

Maximum swing, 10 inches diameter.
Maximum length, 50 inches.
Will grind taper to 1¾ inches per foot.
Wheel spindle bearings, 2¼ inches diameter by 6 inches long.
Size of wheel, 18 by 2 inches.

Number of wheel speeds, 3.
Number of work speeds with cone pulley, 7.
Number of work speeds with geared head, 10.
Number of table speeds, 10.
Maximum table speed, 108 inches per minute.
Number of work rests, 3.
Fast and loose pulleys on countershaft, 14 by 4¼ inches.
Speed of fast and loose pulleys, 350 revolutions per minute.
Floor space required when working full length, 12 feet 8 inches by 3 feet 10 inches.
Approximate net weight, 2½ tons.

The 10 by 50 inch plain grinding machine is designed for plain grinding of shafts up to 10 inches diameter by 50 inches long.

FIG. 33.—A 10 by 50-inch plain grinding machine. Churchill Machine-Tool Company (Limited).

The grinding machine manufactured by Churchill is in general appearance very similar to an American tool. The base rests on three feet. All slides are scraped to master straightedges and are guaranteed accurate. The wheel spindle is hardened and ground and runs in adjustable bronze self-oiling bearings. The wheel feed is automatic and sizes the work within 0.00025 inch. It acts at each reversal of table, and is arranged to advance the wheel an equal amount at each stroke of table. The table travel is automatic and can be stopped at any point of its travel. The reversing is controlled by dogs adjusted along the rack on front of the table. The reversing motion is accurate and will reverse to a line. There is a slight dwell at each end of stroke of table and also a special slip clutch, which avoids shocks of reversal on machine and table gears. The swivel table, which carries

the headstocks, turns on a hardened and ground stud and swivels to 1¾ inches per foot. This table is flat and the headstocks are located against the front edge, assuring alignment of work heads at all positions on table. The tailstock has spring tension to spindle to allow of expansion or contraction of work during grinding. The work headstock has a seven-speed cone pulley and speed obtainable by rack and pinion operating belt forks. The tension belt is kept constant by weighted jockey pulleys. Both head and tail stock spindles are hardened and ground. The table speeds are 10 in number, operated from the front of machine through gear box. The countershaft has ring oiling bearings and self-oiling loose pulley.

Other tools manufactured by Churchill comprise universal relieving lathes, ring grinders, vertical face grinders, and ordinary drills. The last named is of the Prentice type. Messrs. Churchill are handling the Darling & Sellers lathe, and I understand that the price of this machine is about £30 ($146) more than a Lodge & Shipley lathe of the same size. In this connection it is interesting to note that the Ernault (French) lathe is selling here for about the same price as good American lathes. The fact that Ernault tool posts are of steel construction causes them to be regarded favorably. It is also interesting to note that there are a number of English lathes which can be purchased for about one-half the cost of a Reed lathe or other standard American tool, and while it is recognized that these cheaper English lathes are outclassed by the better-grade American tools, still they are often regarded here as good enough for use on a job which is designed to be finished later on a grinding machine.

The Churchill universal relieving lathe is designed to take work up to 12 inches in diameter and 24 inches long. It is entirely universal. The spindle is a high carbon steel forging, and is bored through seven-eighths inch diameter for drawbolt for work arbors, the front bearing being 4¾ inches diameter by 10 inches long, and the back bearing 4 by 8 inches, running in bronze bushes. The drive for this spindle is by a large diameter worm wheel driven by hardened steel worm. The cam shaft is of tool steel, hardened and ground, and runs in bronze bushes. The saddle has a very wide bearing on the bed, with square gibs, taper adjusting strips, handwheel traverse, and provision for locking in any position on bed. The lead screw is 2½ inches diameter by one-half inch pitch. The compound slides have been given great depth, and the dials are graduated to 0.001 inch. The tailstock spindle is bushed with taper bronze bush for supporting end of arbor work. The diameter of the fast and loose pulleys is 14 by 3 inches belt; revolutions of countershaft, 240 for cut, 480 for reverse; approximate weight of tool, 50 hundredweight.

Among the American machine tools in service in the Churchill shops are:

The Binsse Machine Company, Newark, N. J.; F. E. Reed, Worcester, Mass.; Hendey Machine Company, Torrington, Conn.; Cincinnati Milling Machine Company, Bickford Drill and Tool Company, G. A. Gray Company, all of Cincinnati, Ohio; Brown & Sharpe Manufacturing Company, Providence, R. I.; Morse Twist Drill and Machine Company, New Bedford, Mass; Baker Brothers, Toledo, Ohio; Potter & Johnston Machine Company, Pawtucket, R. I.

LOW COST OF RUNNING ENGINES.

The Churchill shops are run with a 120-horsepower gas engine at a cost of but £3 ($14.60) per week, inclusive of a man's wages for at-

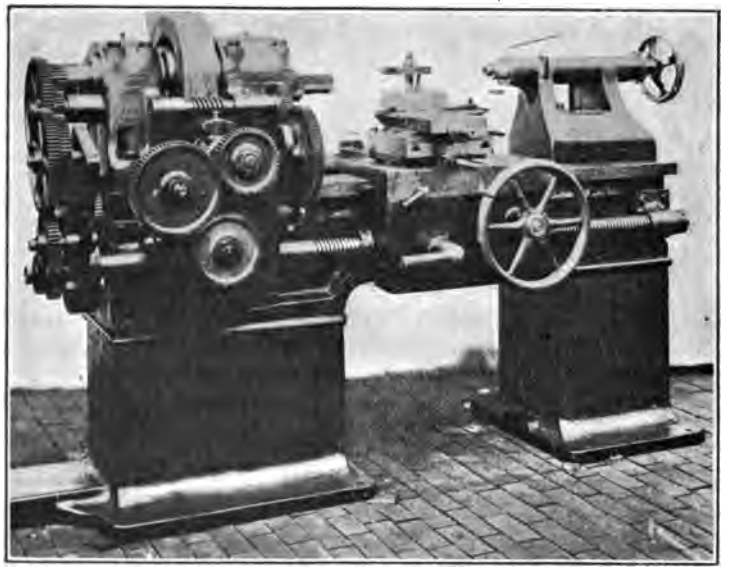

FIG. 34. Universal relieving lathe, Churchill Machine-Tool Company (Limited).

tendance. It is interesting to note that the Weir shops run by gas engine, and, working more than 1,000 men, are run at a cost for drive, I was informed, of 15 shillings ($3.65) per day.

THE WORKS OF GEORGE RICHARDS & CO. (LIMITED), BROADHEATH, ENGLAND.

FACING AND BORING MACHINES.

The firm of George Richards & Co. (Limited), machine-tool builders, of Broadheath, is doing good work. I was prepared to find this, for I have had ample opportunity on the Continent to observe Richards's tools in service. In common with British ideas observed in *other shops*, Messrs. Richards insist in putting plenty of metal into

their tools, for it must be remembered that British manufacturers aim to give their machines long life. My attention has been attracted to machine tools that have been in service in Europe for periods of twenty-five years and upward, and the possessors show no inclination to give them up. When visited on August 13 Richards's shops were working about 500 men. Special attention is being paid to the manufacture of universal facing and boring machines, which appear to do really fine work. A week's work in the shops comprises fifty-three hours, and no time is allowed off during the forenoon hours for breakfast.

I found the following American machine tools in service:

Brown & Sharpe Manfacturing Company, Providence, R. I., gear cutters; Gleason Works, Rochester, N. Y., gear cutter; Norton Grinding Company, Worcester, Mass., grinders; Becker Milling Machine Company, Hyde Park, Mass., millers; Cincinnati Milling Machine Company, Cincinnati, millers; G. A. Gray Company, Cincinnati, planers.

I was informed that all the bevel gears turned out are cut on the Gleason tool, which is liked here very much. Such of the Richards output as goes to Germany is disposed of through Lud. Loewe. Messrs. Richards give a guaranty that certain fixed limits of error on their tools shall not be exceeded. These limits are exceedingly fine.

DIMENSIONS OF MACHINES.

The universal facing and boring machines were designed originally for facing and turning the flanges of pipes. They have been so developed that they are now used as universal boring, facing, and milling tools, and it is claimed that milling of all descriptions may be advantageously performed on these tools. Take, for example, the No. 1 machine, weighing 65 hundredweight, and capable of facing and edging the flanges of pipes, cylinders, etc., up to 22 inches diameter. The principal dimensions of this machine are as follows:

Dimensions of plain or cross-sliding table, 42 by 30 inches; dimensions of top or revolving table, 30 by 30 inches.

The cross-sliding table has an automatic longitudinal feed of 34 inches and a cross feed by hand of 36 inches.

The facing-head slide carrying the tool moves automatically in either direction and has a roughing feed of 23 to the inch inward, and a finishing feed of 11½ to the inch outward, leaving the head ready for another flange or for truing up the edge, which is done by means of the automatic longitudinal table feed of 16 or 32 to the inch. This description is applicable to the plain machine only.

The center of facing head is capable of vertical adjustment from 5 inches to 16 inches above top of revolving table, and from 9 inches to 20 inches above plain table.

The spindle has 24 speeds, ranging from 2 to 68 revolutions per minute.

The bed is 6 feet long from face of upright.

The machine is powerfully geared with full and intermediate back gear trains, and is capable of taking the heaviest cuts required in facing work.

The countershaft has fast and loose pulleys 10 inches in diameter for two 2½-inch belts and should make 366 and 420 revolutions per minute.

The machine is complete with boring stay, countershaft, hangers, belt-striking gear, screw keys, and wheel guards.

All gearing machine cut from solid blanks.

SLOT DRILLING AND KEYWAY CUTTING.

Richards & Co. are turning out a slot-drilling and keyway-cutting machine, entirely automatic in its movements. No. 1 is intended for key beds to 20 inches long and 1 inch wide and No. 3 will handle key beds to 3 feet 6 inches long and 2½ inches wide in shafts to 18 inches diameter. The spindles of these machines are driven by belt to impart a smooth motion to the cutting tool. In No. 1 the spindle has a self-acting vertical feed of 2 inches and in the case of No. 3 a vertical feed of 6 inches. An automatic stop is provided for gauging the depth of cut. A hand longitudinal adjustment is given to the spindle frame actuated by a handwheel at the end of the slide. This permits of the spindle frame being brought to the position required prior to the automatic traverse being set in operation.

In No. 1 the table is 24 by 8 inches and has a vertical adjustment of 12 inches. There is also a cross movement of 3 inches to enable the machine to be used for any kind of cotter cutting. No. 3 has a table measuring 4 feet 6 inches by 16¼ inches with a vertical adjustment of 15 inches and a cross movement of 6 inches. No. 1 has three spindle speeds and No. 3 four spindle speeds. No. 1 has a countershaft with pulleys 8 inches in diameter for a 3-inch belt and is best driven at 150 revolutions per minute. It weighs complete 13 hundredweight and covers a floor space measuring 5 feet by 3 feet 2 inches. The countershaft of No. 3 has pulleys 14 inches in diameter for a 3½-inch belt and is best worked at a speed of 120 revolutions per minute. This machine weighs complete 52 hundredweight and covers a floor space measuring 8 feet 6 inches by 5 feet 3 inches. The keyway slotters are much in demand on the Continent. From what I can learn this tool does satisfactory work.

The list of tools manufactured by Messrs. Richards comprise, in addition to those already mentioned, radial drilling machines, horizontal boring machines, boring and turning mills, ranging in capacity

from 3 feet to 16 feet in diameter, combined turret head, boring and turning machines, vertical milling machines, special grinding machine for piston rod, etc., and band sewing machines.

THE WORKS OF DARLING & SELLERS (LIMITED), KEIGHLEY, ENGLAND.

The machine-tool works of Darling & Sellers (Limited) are located at Keighley, a town not far from Leeds. In my report on

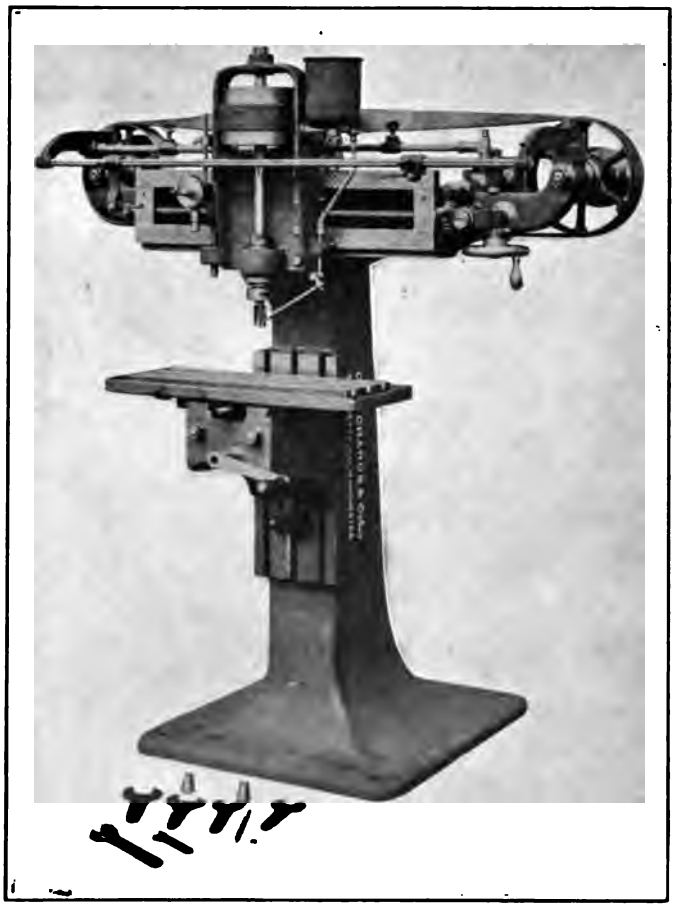

FIG. 35.—Slot-drilling and keyway-cutting machine of Geo. Richards & Co. (Limited).

the Swiss electrical house known as "Maschinenfabrik Oerlikon" it was stated that the opinion was there expressed by one of the directors of that concern that the Lodge & Shipley high-speed engine lathe was superior to any foreign lathe in the shop, and that this particular tool yielded a saving of 30 per cent in cost of production over any European lathe, barring only that of Darling & Sellers. This high estimate of the Darling & Sellers lathe I found borne out by

other independent opinions. The value of this English lathe lies in its strength, solid construction, and good assembling features. It is not a cheap tool. A Darling & Sellers lathe of the same size as the Lodge & Shipley is being sold for £30 ($145.80) more than the American tool.

The Darling & Sellers shops are not extensive, nor can they be called very modern. On the contrary, it is rather an old plant and essentially British in type. They do honest work, however, perhaps a trifle slow from the American standpoint, but there is no gainsaying that when they finish and send out a lathe the buyer has a tool good for twenty years or more of heavy work. Darling & Sellers, John Lang & Sons, and Alfred Herbert are the three English firms which for medium-sized lathes may be regarded as offering competition in this line of products to American manufacturers who are selling abroad.

SPECIAL FEATURES OF AN ENGLISH LATHE.

In the case of the 16½-inch Darling & Sellers lathe, the leading dimensions are as follows:

Maximum length admitted, with 18 feet bed, 8 feet 2 inches.
Maximum diameter which will clear over saddle, 1 foot 10½ inches.
Effective width of bed, 2 feet 5 inches.
Main spindle bearing, diameter and length, 7 by 10½ inches.
Driving cone, diameter and width of largest speed, 35 by 6¼ inches.
Ratios of gearing, fast and slow, 6 and 14.7 to 1.
Spindle speeds, for each speed of counter shaft, 12.
Feed rates, in fractions of an inch per revolution, $\frac{1}{32}$, $\frac{1}{16}$, $\frac{1}{8}$, and $\frac{1}{4}$ inch.
Floor space, with 18 feet bed, 19 feet 9 inches by 5 feet 8 inches.
Net weight, with 18 feet bed, 11 tons.

The patent bed is of the double-tier type. The whole of the gearing is mounted on a massive headstock, placed in advance of the driving cone, which is not only of enormous size, but has the further advantage of unlimited belt angle. The steel spindle revolves in three large bearings of antifriction bronze, with provision for receiving endway pressure and taking up wear.

CONSTRUCTION AND PERFORMANCE.

The driving gear is of two ratios, so proportioned that the changes from belt to low ratio of gear, and from the latter to the high ratio, advance uniformly in geometrical progression. By this introduction of low-ratio gear, in conjunction with the wide belt, heavy cuts can be taken at a high speed on work of moderate diameter. This is deemed an exceptionally valuable feature in connection with modern high-speed tool steels. The loose headstock has a steel spindle of very large diameter with long bearing and split clamp for locking. The front standard is cut away to clear the compound rest, and cross ad-

justment is provided for dealing with slight tapers, unless otherwise ordered. The compound rest has large wearing surfaces and is capable of being swiveled to any angle. The controlling handles are grouped on the saddle itself immediately under the hand of the operator, who is thus enabled to reserve or release the feed without withdrawing his attention from the cut. The feed engagement, both sliding and surfacing, is by friction clutches. The feed change is instantaneous, without stopping the lathe, which is made with the first driver of the feed change gears, a nonshifting belt of ample width to take the heaviest cuts, but affording a slipping point in case of mishap, with gear drive throughout. The gearing machine is cut from the solid, throughout the lathe, including the racks, which are of forged steel.

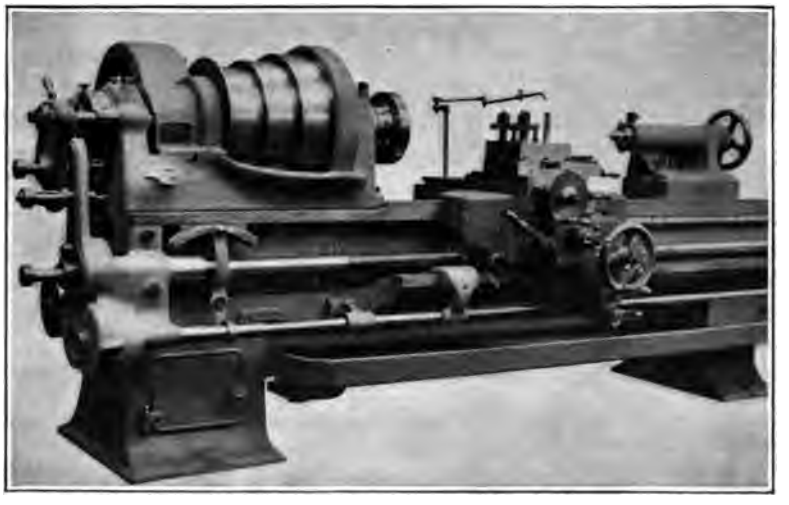

FIG. 36.—Darling & Sellers's engine lathe.

THE DARLING & SELLERS LATHES.

Messrs. Darling & Sellers have been lathe builders since 1853. One of the striking features of their ordinary type lathe is its length of life. The necks are taper and project about ¾ inch, to allow for adjustment in taking up wear and keeping alignment. This feature has been incorporated in the earliest-made lathes of this firm, and the statement was made to me that there are lathes working to-day which have been in service for forty-five years, with still as much as ⅜ inch of taper projecting, to allow of further adjustment before the stout collar is reached, which serves as a face for chucks or face plates screwed onto spindle nose. The same old lathe, it is stated, has not required rebushing. Bushing is done with gun metal. These lathes were of the ordinary type, with conical necks hardened and ground true. The present-day lathe of Messrs. Darling & Sellers, namely, the patent high-speed type, has parallel necks.

SPUR-GEAR CUTTING MACHINE.

Messrs. Darling & Sellers are turning out a number of machine tools, but my attention was particularly attracted to a spur-gear cutting machine which is completely automatic. In this machine the work is mounted in a horizontal plane with arbor vertical, and the cutter is fed down to the work. The claim is made that this is the rational position, and that the advantages are greater ease in mounting and removing the work, greatly reduced risk of straining the arbor, since the work is always perfectly in balance, and that the cuttings fall away before the cutter instead of accumulating upon and clogged it. The dividing wheel is completely incased. On being automatically freed from the feed mechanism at the completion of each stroke, the cutter slide ascends instantaneously, silently, and without shock, until arrested at the proper moment by its adjustable cushion of compressed air. This form of movement, it is claimed, avoids the objectionable wear and tear of rapidly revolving parts, and, it is asserted, results in a saving of time. There is a special patent device which seems to insure adequately any risk of reengagement of feed before the spacing change has been completed. This patent device, it is claimed, removes all fear of spoiling the wheel. The spindle drive is secured by the employment of spur gears throughout in combination with a simple arrangement of pulleys, and a quick withdrawal of work from the cutter is effected by means of a lever-regulated rack motion.

The principal dimensions of a 48-inch machine of this type are as follows:

Smallest pinion admitted, 2¼ by 9 inches. Number of feed changes.
Largest wheel admitted, 48 by 9 inches. Diameter sample cutter arbor, 1¼ inches.
Largest diametrical pitch, 3 inches. Diameter sample work arbor (to order).
Largest circular pitch, 1 inch. Floor space, 7 feet 9 inches by 4 feet.
Number of spindle speeds, 3. Net weight, 52 hundredweights.

In the case of the 72-inch machine, the particular dimensions are as follows:

Smallest pinion admitted, 3 by 16 inches. Number of feed changes, 9.
Largest wheel admitted, 72 by 16 inches. Diameter sample cutter arbor, 1¾ inches.
Largest diametrical pitch, 1¼ inches. Diameter sample work arbor (to order).
Largest circular pitch, 2½ inches. Floor space, 11 feet 2 inches by 6 feet.
Number of spindle wheels, 7. Net weight, 7 tons.

Messrs. Darling & Sellers were working at the time of my visit (August 14) about 160 men. Fifty-four hours constitute a week's work, and there is no recourse to piecework. The average wage for a good tool man is about 32 shillings ($7.68) per week.

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